Acerca de este libro

Esta es una copia digital de un libro que, durante generaciones, se ha conservado en las estanterías de una biblioteca, hasta que Google ha decidido escanearlo como parte de un proyecto que pretende que sea posible descubrir en línea libros de todo el mundo.

Ha sobrevivido tantos años como para que los derechos de autor hayan expirado y el libro pase a ser de dominio público. El que un libro sea de dominio público significa que nunca ha estado protegido por derechos de autor, o bien que el período legal de estos derechos ya ha expirado. Es posible que una misma obra sea de dominio público en unos países y, sin embargo, no lo sea en otros. Los libros de dominio público son nuestras puertas hacia el pasado, suponen un patrimonio histórico, cultural y de conocimientos que, a menudo, resulta difícil de descubrir.

Todas las anotaciones, marcas y otras señales en los márgenes que estén presentes en el volumen original aparecerán también en este archivo como testimonio del largo viaje que el libro ha recorrido desde el editor hasta la biblioteca y, finalmente, hasta usted.

Normas de uso

Google se enorgullece de poder colaborar con distintas bibliotecas para digitalizar los materiales de dominio público a fin de hacerlos accesibles a todo el mundo. Los libros de dominio público son patrimonio de todos, nosotros somos sus humildes guardianes. No obstante, se trata de un trabajo caro. Por este motivo, y para poder ofrecer este recurso, hemos tomado medidas para evitar que se produzca un abuso por parte de terceros con fines comerciales, y hemos incluido restricciones técnicas sobre las solicitudes automatizadas.

Asimismo, le pedimos que:

+ *Haga un uso exclusivamente no comercial de estos archivos* Hemos diseñado la Búsqueda de libros de Google para el uso de particulares; como tal, le pedimos que utilice estos archivos con fines personales, y no comerciales.
+ *No envíe solicitudes automatizadas* Por favor, no envíe solicitudes automatizadas de ningún tipo al sistema de Google. Si está llevando a cabo una investigación sobre traducción automática, reconocimiento óptico de caracteres u otros campos para los que resulte útil disfrutar de acceso a una gran cantidad de texto, por favor, envíenos un mensaje. Fomentamos el uso de materiales de dominio público con estos propósitos y seguro que podremos ayudarle.
+ *Conserve la atribución* La filigrana de Google que verá en todos los archivos es fundamental para informar a los usuarios sobre este proyecto y ayudarles a encontrar materiales adicionales en la Búsqueda de libros de Google. Por favor, no la elimine.
+ *Manténgase siempre dentro de la legalidad* Sea cual sea el uso que haga de estos materiales, recuerde que es responsable de asegurarse de que todo lo que hace es legal. No dé por sentado que, por el hecho de que una obra se considere de dominio público para los usuarios de los Estados Unidos, lo será también para los usuarios de otros países. La legislación sobre derechos de autor varía de un país a otro, y no podemos facilitar información sobre si está permitido un uso específico de algún libro. Por favor, no suponga que la aparición de un libro en nuestro programa significa que se puede utilizar de igual manera en todo el mundo. La responsabilidad ante la infracción de los derechos de autor puede ser muy grave.

Acerca de la Búsqueda de libros de Google

El objetivo de Google consiste en organizar información procedente de todo el mundo y hacerla accesible y útil de forma universal. El programa de Búsqueda de libros de Google ayuda a los lectores a descubrir los libros de todo el mundo a la vez que ayuda a autores y editores a llegar a nuevas audiencias. Podrá realizar búsquedas en el texto completo de este libro en la web, en la página `http://books.google.com`

This is a reproduction of a library book that was digitized by Google as part of an ongoing effort to preserve the information in books and make it universally accessible.

Google™ books

https://books.google.com

THE UNIVERSITY
OF ILLINOIS
LIBRARY

338.05
ELE
v. 38

338.05
ELE
v.38

The pages which are missing were removed because they were advertisements

A PRACTICAL TRADE JOURNAL

No. 1730.—Vol. XXXVIII. FRIDAY, JANUARY 4, 1924. Price Twopence.

CONTENTS.

	PAGE
Wireless in the Arctic	1
The New Constant Pressure MEG Insulation Tester	3
Students in Electricity Undertakings	4
A Simple Spot Welder for Light Experimental Work ...	4
Current Topics	7
A "C.T.S." Competition	8
Diaries, Calendars, etc.	9
Answers to Correspondents	9
Questions and Answers by Practical Men	10
V.I.R. Cables—Their Manufacture and Selection... ...	13
Reviews of Books	14
Trade Notes	14
Various Items	14

WIRELESS IN THE ARCTIC.

A most interesting example of the application of wireless is furnished by the record of the Second Merton College Arctic Expedition to Spitzbergen, during the period June 14 to September 15, 1923.

This expedition was a private adventure organised by Mr. George Binney, of Merton College, Oxford, and had for its objects natural history observation, geographical survey and geological research, combined with the pleasures and possibilities of big game hunting.

A glance at the map, reproduced in Fig. 1, shows the venue of the trip. The first intention was to land a sledge party at some such point as *A*, in North-East Land, and to pick them up again at point *B*. An alternative route for the sledge party was to be from *A* to *C*, then across the Hinlopen Strait by means of a boat left at *C*, and across New Friesland to point *D*. The area about *D* had been previously surveyed on a former expedition in 1921.

To enable the sledge party to learn from the ship whether it would be possible to keep the rendezvous at *B*, or whether they should branch off on the alternative route, it was decided to instal a wireless transmitting set in the parent ship, and to equip the sledge party with a portable receiving apparatus.

The transmitting and receiving apparatus fitted on board was of standard Burndept manufacture, supplied to the expedition by the makers.

The question of receiving set for the sledge party, however, had to receive special consideration. The sledges were to be operated by man power, and the weight of the apparatus had to be reduced to a minimum. Moreover, no facilities would exist en route

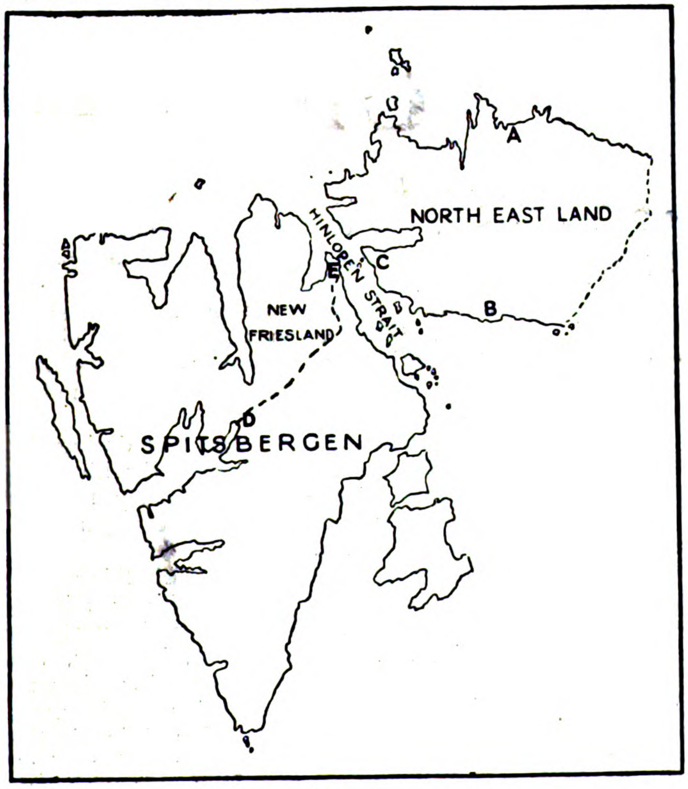


FIG. 1.

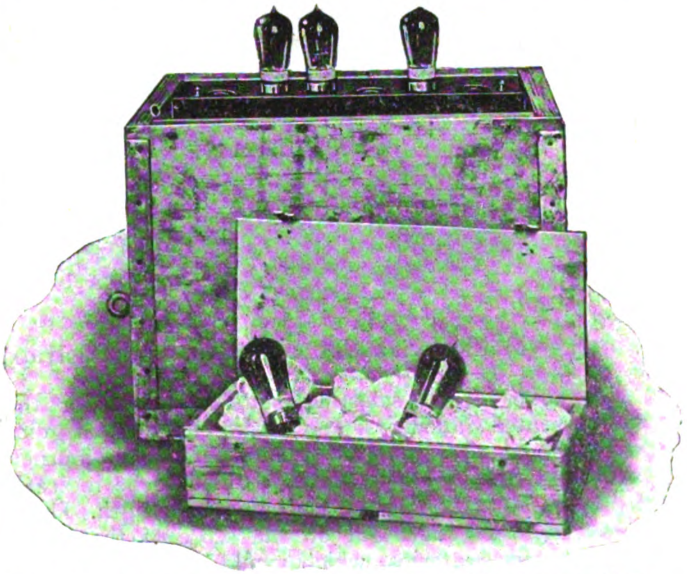


FIG. 2.—SLEDGING FOOD BOX WITH RECEIVING SET IN POSITION, ALSO SHOWING METHOD OF PACKING D.E.R. VALVES.

20 Nov. 25 JMH
AUG 13
583085

for charging accumulators for filament heating supply. Ultimately a special receiving set was designed and made by Mr. Relf, who was in charge of radio or surveying from the ship, and the views of this apparatus shown in Figs. 2 and 3 and the following description will be of interest to our readers.

The set was made to fit the standard sledging food box, shown in Fig. 2. A standard three-valve circuit (one H.F., one detector, and one L.F. valve) was employed, and, as will be seen, a very neat little set was produced. Standard "Gecophone" components were used exclusively in making up the set, these being kindly presented to the expedition by the General Electric Co., Ltd.

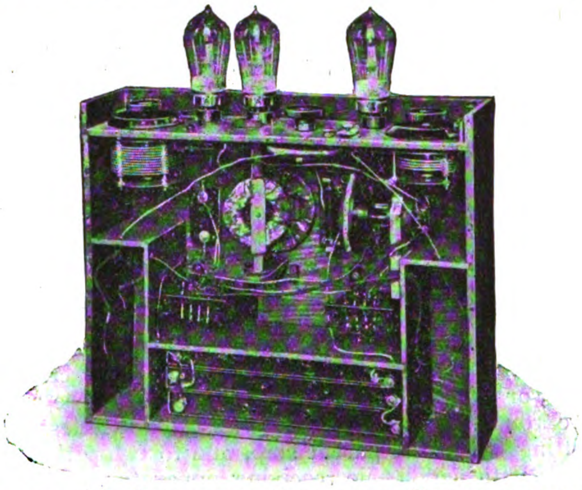


FIG. 3.—(*a*) RECEIVING SET WITH FRONT REMOVED, SHOWING "GECOPHONE" COMPONENTS.

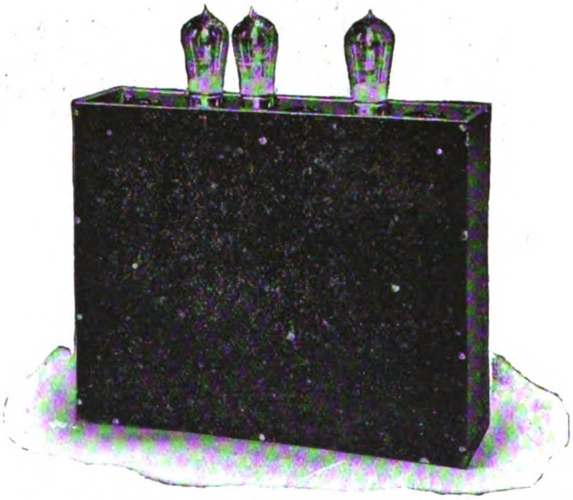


FIG. 3.—(*b*) RECEIVING SET WITH COVER IN POSITION.

The question of selecting suitable valves for this set presented difficulties. It was anticipated that going would be rough during the greater part of the journey, and standard "R" type valves seemed to be indicated from the point of view of mechanical strength. These, however, were ruled out on the score of the weight of secondary batteries, which would be necessary, and it was ultimately decided to instal Marconi D.E.R. type dull-emitter valves.

Careful calculation showed that sufficient energy for filament heating could be obtained from two 22 ampere hour (actual) batteries, and these, fully charged, of the Fuller "Block" type, were included in the equipment when the sledge party left the ship. Actually they ran the valves whenever necessary during the journey, and were not completely exhausted when the sledge party was ultimately picked up.

By the kindness of the General Electric Co., Ltd., six Marconi D.E.R. valves were taken with the party. These were packed in ordinary cotton wool in a rough wooden case (shown in Fig. 2), and this case was carried in one of the sledges. One of the valves came to an untimely end by accident before the sledge party started, but the remaining five survived until the commencement of the last eight miles of the overland journey, when extremely rough going was experienced, as shown in the illustration (Fig. 4), which resulted in the loss of two more valves. The three remaining valves, however, did good service until the end of the journey, and are to-day still capable of further use.

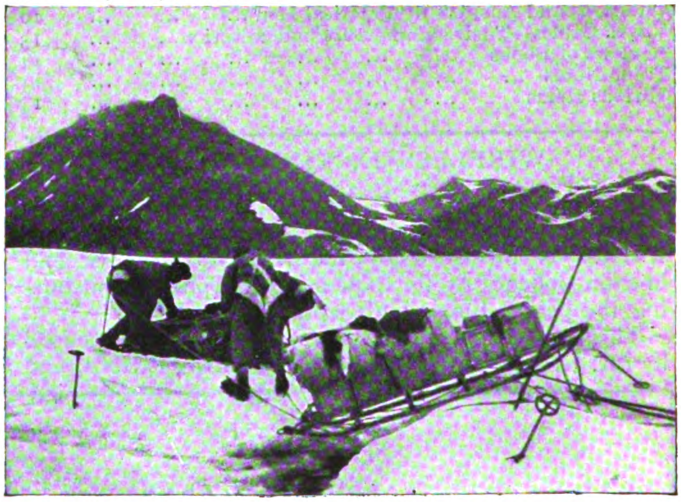


FIG. 4.—ROUGH GOING AT SPITZBERGEN.

The total weight of the receiving apparatus, including the batteries, was only twenty pounds. The aerial consisted of three seven-foot bamboo poles, which could be fitted together, and an eighty foot length of aerial wire leading from the top to a short pole six feet high. The lead-in was from the higher end. The earth consisted of a similar length of bare copper wire laid along the ice immediately underneath the aerial.

As regards results, we are informed that during the whole of the journey the ship was received with satisfactory clearness whenever the sledge party listened in. A view of the party picking up messages from the ship is shown in Fig. 5.

It will be easily appreciated how valuable this equipment would have been in the case of any mishap which would prevent the ship taking up the party at the appointed place. As it happened, however, the original programme had to be abandoned, as it was found impossible, owing to the condition of the pack ice, to bring the ship round to position *A* in North-East Land. Actually, the sledge party was landed at point *E*, at the north of New Friesland, and the route travelled was approximately that shown by the dotted line, the party actually being picked up at *D* in accordance with plan. Although the set was not called upon to take part in any emergency, during the last stage of the journey, when it was finally established by wireless that the party would be picked up safely at the appointed time, it was found possible to abandon certain stores, and thus lighten the load over a particularly rough bit of country.

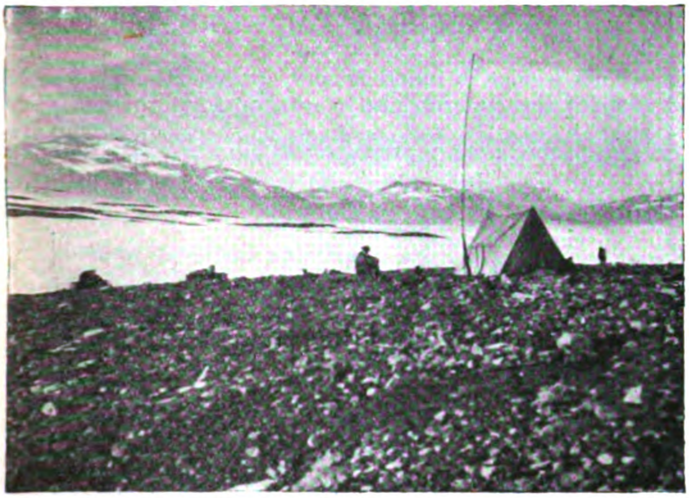


FIG. 5.—VIEW SHOWING AERIAL, WITH A MEMBER OF THE EXPEDITION RECEIVING SIGNALS FROM THE PARENT SHIP.

We are indebted to Mr. Ernest F. Relf, a member of the expedition, for the information contained in this article, and for his permission to reproduce photographs.

THE NEW CONSTANT PRESSURE "MEG" INSULATION TESTER.

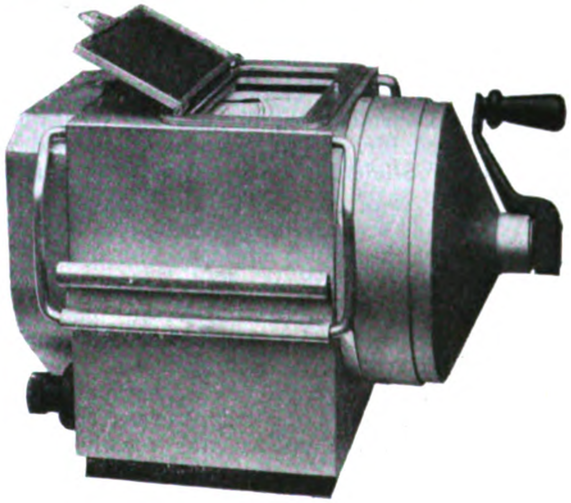
In the short space of fifteen months since the MEG Insulation Tester was placed on the market by Messrs. Evershed and Vignoles, Ltd., Acton Lane Works, Chiswick, W.4, the instrument has attained wide popularity on account of its lightness and compactness.

It may be remembered that the weight of the complete instrument, comprising a 500-volt generator, a moving-coils ohmmeter unit, and the totally enclosed driving gear, was only 6½ lb. Such a drastic reduction in weight, accompanied by corresponding reductions in size and price, was only rendered possible by concentrating on the absolute essentials of an insulation tester, discarding all the luxuries and refinements which have contributed to the world-wide fame of the larger "Megger" testing sets.

Amongst other things the constant pressure clutch was dispensed with, since a variable pressure instrument has been found to be quite satisfactory for testing circuits of small electrostatic capacity. This form of clutch was patented and applied to the "Megger" sets by Mr. Evershed, nearly twenty years ago, although variable pressure instruments are still supplied for certain purposes. In view of the general appreciation which has been accorded to the lighter instrument, however, efforts have been made to extend its scope and utility without sacrificing lightness and convenience. A marked advance in this direction is the introduction of the constant pressure clutch in a modified form suitable for the MEG, and the instrument embodying this improvement will be placed on the market on January 1.

From the illustration it may be seen that the Constant Pressure MEG differs little in general appearance and size from the original instrument. The only change is the introduction of a "Sandwich" unit between the generator unit and the gear casing. This unit carries the copper driving drum of the clutch and the intermediate gearing and stud, transferred complete from its previous position on the generator frame. The other clutch member is attached to the armature spindle and consists of a plate carrying spring-controlled levers and pressure pads, so arranged that the driving elements will separate under centrifugal action when the armature speed exceeds a predetermined limit. Normally the speed at which this occurs corresponds to about 500 volts.

Specially made roller bearings provide for long life of the generator at the high speed (approximately 4,500 r.p.m.) at which the armature runs, and at the same time allow the armature clearance to be kept down to a minimum. With the addition of the Constant Pressure Clutch the complete instrument weighs only 7¼ lb., whilst the overall measurements when open ready for use are 5½ in. by 6¼ in. by 8½ in.



Advantages of Constant Pressure Type.

When a testing voltage is applied between two insulated conductors, or an insulated conductor and earth, a current will flow until the system, which actually forms a condenser, is charged up to the applied potential. Perfect insulation does not prevent the flow of this current, which, however, ceases as soon as the system is fully charged, provided that the voltage is maintained constant. Should there be any variation in pressure, a varying capacity current would flow in either direction, according to whether the voltage were rising or falling. In measuring insulation resistance, such currents are naturally superimposed on the leakage current, rendering a steady reading extremely difficult to obtain when the capacity of the system is large.

For a large variety of work on machines, switchgear and ordinary house wiring, the capacities encountered are so small that the correspondingly minute capacity currents do not interfere with a steady reading, even with a variable pressure instrument.

Limit of the Variable Pressure Type.

When, however, the capacity reaches the order of 1 microfarad, a steady reading becomes increasingly difficult to obtain unless some method of controlling the testing voltage is introduced. This is effected automatically and within narrow limits by the Constant Pressure Clutch, so long as the handle of the generator is turned at a speed exceeding that at which the clutch can be felt to slip. By this means the scope of a testing set may be extended to cover circuits consisting of long runs of cable, metal sheathed wiring, armoured cable, etc.

With the extended use of lead-covered systems these facts are of greater importance, as the wiring of a large building may have considerable capacity. We are informed by Messrs. Henleys that the capacity of their lead-covered house wiring is .4 microfarad per mile, whilst the capacity of smaller sizes of distributing cable is about the same.

There is another important advantage of the constant pressure instrument, in that it is impossible to overstrain the insulation under test. With the variable pressure generator, two or even three times the rated voltage may be obtained by turning sufficiently fast, whereas the use of such pressures is undesirable in some cases.

STUDENTS IN ELECTRICITY UNDERTAKINGS.

At the meeting of the Informal Section of the I.E.E. on Monday, December 17, Mr. P. Dunsheath was in the chair when Mr. G. R. A. Murray opened a discussion on "Students in Electricity Undertakings."

Mr. Murray is of the opinion that electricity works give very limited scope to the student, and he reviewed the prospect of the young engineer who found himself engaged in this department of the industry.

Captain J. M. Donaldson endorsed many of the opener's views, and pointed out that the number of posts of chief engineer, or even station superintendent, is very limited, while the job of shift engineer is mainly a dead-end and should not attract the enterprising type of student whom the opener was mostly concerned about. The seniors did not want inventiveness or enterprise so much as efficiency from the young men, and any junior of spirit should try and get outside experience even if it means giving up a more lucrative post as shift engineer.

He mentioned that some years ago he spent two years or so in the U.S.A. and Canada, but he did not find the ex-university men he had as colleagues were as soundly grounded as the students turned out by English colleges.

Mr. A. F. Harmer compared the prospects offered by engineering works and supply undertakings, and expressed his pleasure at the decay of the premium pupil system.

Mr. E. F. Hetherington stated that a young man should not go into a power station unless he is fitted for it and is prepared to stay in it. If he feels unfitted he should get into the sales or distribution side as soon as he can.

Mr. P. Dunsheath reminded the meeting that the supply stations are far from standardised; the size of the units, matters of fuel, handling of ash, etc., are only a few of the problems requiring closest study. Many of the presidential addresses in the past had touched on the subject of this night's discussion, and many of them, particularly that of Mr. Ll. B. Atkinson, were most stimulating.

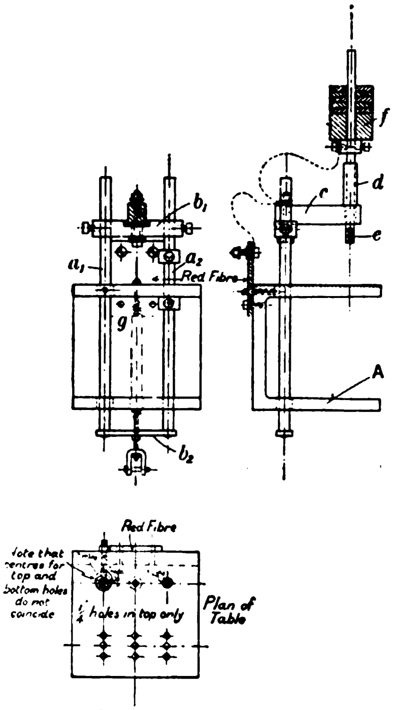
Messrs. F. Pooley, G. W. Preston, W. E. Rogers and J. W. Thomas also spoke.

A SIMPLE SPOT WELDER FOR LIGHT EXPERIMENTAL WORK.*

This welder is found a very convenient and flexible tool for the experimental workshop for light and very light work. It will spot weld sheet metal up to 1-16 inch thick, but is used mainly for sheet nickel 0.1 and 0.15 mm. thick, and wire from lamp filament sizes up to 1.25 mm. in diameter.

A cast-iron base *A* of channel section carries a sliding frame made of two $\frac{1}{2}$-in. rods a_1 and a_2 joined by two cross-bars b_1 and b_2. The upper cross-bar carries a projecting arm *c* with a vertical tube *d* at the end. The projecting arm and tube are insulated from the cross-bar and the base. A $\frac{3}{8}$-in. copper rod *e* slides freely in the tube *d* and carries disc weights *f* on a collar. The lower end of the rod *e* is tapped 0 B.A. to hold a suitable copper welding point.

One terminal is connected through flexible tape to the copper rod *e* and the other is connected to the iron base *A* or to any jig or work holder which may be bolted to the iron base.


f
d
c
e
b_1
a_1
a_2
Red Fibre
g
A
b_2
Red Fibre
Note that centres for top and bottom holes do not coincide
$\frac{1}{4}$ holes in top only
Plan of Table

G.E.C. RESEARCH LABORATORIES.

The terminals are connected to a transformer of 1 k.v.a. capacity with a suitable primary voltage and frequency and secondary tappings .67 to 3.35 volts.

An *H* and *H* rotary switch is used in the primary circuit, and this should be rated at 20 or 30 amperes to deal with the momentary overload at the instant of weld; there is also an adjustable rheostat in the primary circuit. The sliding frame is kept normally at the top of its travel by a spiral spring, indicated at *g*, but can be lowered by a foot pedal so that the welding point on the end of the rod *e* rests on the work to be spot welded with a pressure depending on the number of loose weights placed on the rod.

The welding is done by rotating the *H* and *H* switch half a turn, on and off again.

The top of the iron base is machined, measures 6 in. square, and has holes for conveniently attaching jigs for holding work.

---

* *Journal of Scientific Instruments.*

Don't worry! THERE IS A BENJAMIN REFLECTOR for EVERY CLASS of LIGHTING INSTALLATION.

Advert. of the Benjamin Electric Ltd., Brantwood Works, Tariff Road, N.7.

TO OUR READERS.

ELECTRICITY is published every Friday and, is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and Abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Tuesday morning, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

The C.T.S. Competition.

I am glad to hear that the extension of time for this competition has met with very general approval. C.T.S. cable has been used in such diverse conditions in the electrical industry throughout the last few years that it is certain to have many kindly, and possibly some unkindly, critics. The St. Helens Company want to have all shades of opinion, because they may thereby obtain some information which will enable them to improve their product or in some way help them to overcome any difficulties which the users may have experienced, and anything which helps to do that with a section of the plant or apparatus used in the safe and efficient production or distribution of electricity is naturally to the good of the whole. The complete details of the competition are repeated on another page in the current issue, and I hope my readers will help to make it known as widely as possible, as I anticipate that the winning article will be very interesting reading.

Those Breakdowns.

May I congratulate "A Station Engineer" upon his very able defence of his professional brethren in the correspondence columns of a recent issue. I hasten to add that my past criticisms of the all too frequent electricity supply failures are made in no carping spirit, but with a full knowledge of the worries and anxieties which beset the engineer responsible for electricity supply over a large area, and are prompted by a desire to bring home to these gentlemen the vital importance of eradicating those weak links in their organisation which are at present causing so much trouble in various quarters. It is quite in order for "A Station Engineer" to plead the complications of our existing systems of electricity supply, the many possible sources of weakness and the lack of storage facilities to provide against a sudden failure of part of the generating plant.

At the same time our duty as engineers is to maintain the continuity of supply at all times, and thereby foster in the minds of the consuming public that spirit of confidence without which our many power stations would eventually shut down through lack of support. Already the increasing frequency of electricity failures is giving rise to a great deal of adverse comment in several quarters, born of the inconvenience and danger arising from these sudden and unexpected stoppages. Inconvenient questions are being asked at Town and City Council meetings, and more than one engineer has been called upon of late to render a fully detailed report of his investigations into the circumstances of a breakdown or series of breakdowns.

Thus at Brighton recently Mr. J. Christie reported on the three successive failures of the local service, and had to admit that two of them were entirely due to the fallible human element—in other words, carelessness on the part of certain employees of the electricity station—and doubtless if other of the many supply failures which have occurred of late were fully analysed as to their originating cause, similar explanations would be forthcoming. Familiarity breeds contempt, and especially in these days of automatic control gear, when some of the modern stations are practically capable of looking after themselves, there is a tendency to trust to luck, and place altogether too much faith in the multiplicity of "gadgets" which go to the make-up of a large power station. In these complex organisations, a sudden derangement of the smallest piece of gear or apparatus is calculated to lead to far more serious trouble in a very short while if not immediately attended to, and there is little doubt in my mind that the growth of the "automatic" control idea has something to do with these breakdowns.

When a large station has been humming merrily for hours at a stretch with very little effort or attention on the part of those in charge, there is a very natural and human tendency to assume that, in the words of a certain popular dance melody, it will "Keep on Humming" indefinitely, and so things are gradually left more and more to look after themselves until the inevitable happens, and the public are once again subjected to a sudden spell of darkness just at the busiest hour in some important shopping or business centre. My theory is strengthened by the fact that breakdowns were seldom heard of in the earlier days of electricity supply, when they would naturally bulk larger in the eyes of the public than to-day when electric light and power are commonplace. In those days the engineer was a thoroughly trained and experienced man, and practically all stations were subject to manual control by responsible switchboard attendants, who never left their posts whilst on duty.

A breakdown ten or fifteen years ago was almost invariably due to unforeseen failure of some portion of the plant, like the serious disaster which affected the Manchester station at Dickinson Street in the time of Mr. Wordingham's control, and was due to a burst steam main. I happen to know personally one of the men who was present on that memorable occasion, and who, as he related, never stopped running until he got home, slightly scalded, but otherwise unharmed. With all due deference to "A Station Engineer," therefore, I hope that my honest criticisms will sink in in the right quarter, and create in the thinking type of engineer an ideal to be aimed at during 1924 and after, viz., to do his utmost by intelligent anticipation and eradication of known weaknesses in the system under his control, to create a non-stop record for his station. It is a worthy ideal for every conscientious power station engineer throughout the country. I might add, by way of sequel, that since I last touched on this subject, additional failures have been reported at Poplar, Acton, West Ham, Sherwood (Notts), Wolverhampton, Stoke Newington, and Edinburgh.

Broadcasting.

I would like to take this opportunity of congratulating the various B.B.C. station staffs upon the very excellent programmes with which they entertained us during Christmas week. They certainly worked hard during the hours when most of us were enjoying our Christmas fare and the accompanying festivities, and I personally danced for two hours on Christmas night to the strains of the Savoy Orpheans Band. By their continued efforts to furnish generally acceptable programmes, the B.B.C. are doing their fair share towards maintaining and increasing the popularity of the new pastime, all of which is good for trade. The demand for wireless sets and associated apparatus up to Christmas was unprecedented, and emphasises the suitability of this class of manufactured electrical product for presents.

Incidentally, it is wonderful where all the headphones and loud-speakers go to. I know of one firm which was working practically night and day throughout December to keep pace with the demand for its popular headphone, but was nevertheless ten thousand pairs behind its commitments on Christmas Eve. Similarly, that firm's supply of an equally well-known loud-speaker was sold out just before the holidays, and they are now working full speed to overtake a post-Christmas demand. It certainly looks as if the alleged "boom" has come to stay this time. In this connection there is one step that everyone of us listeners will have to take a hand in, and help the B.B.C., and incidentally ourselves, to secure uninterrupted enjoyment of the programmes. We must band together in a common endeavour to eradicate or exterminate, if need be, the oscillating fiend. Latterly he has been much in evidence in various quarters, and, although some of this screeching and howling is probably due to a number of newly-acquired sets in the hands of ignorant users, there is nevertheless a percentage of deliberate spoliation of the transmission by these mischievous and thoroughly objectionable people. I heard one of these Oscillating Huns run up and down the scale of irritating howls the other night, just in the middle of a very excellent vocal item; that is the type of microbe we must speedily subject to a germicide if the great majority are to enjoy their nightly programmes. My advice to listeners-in is to look out for newly-erected aerials in their immediate vicinity directly they begin to be bothered with this nuisance, and pay an early visit to the probable offender.

Hearty Congratulations.

Just as I conclude these notes I have been called away to listen to an orchestra in Pittsburg playing "We Won't Go Home Till Morning." The music was clearly reproduced on a Claritone loud-speaker, through the medium of an Ashley five-valve set in a house in the North of England. It is nothing novel to pick up America these days, but the novelty in this case consisted in the reception, amplification, land line transmission, broadcasting, and subsequent reception again by wireless in the final stage, without sufficient loss of character of the original music to render it unintelligible. It is indeed a wonderful achievement of the B.B.C. thus to relay music and speech received from the U.S.A. to all its provincial stations, and through them to listeners throughout the British Isles. It marks another epoch in the history of wireless telephony, and I tender my hearty congratulations to the B.B.C. engineers, who certainly have created a record in this connection.

ELEKTRON.

A "C.T.S." COMPETITION.

The St. Helens Cable and Rubber Co., Ltd., of Slough, who hold a world-wide reputation as the inventors of the famous C.T.S. (Cab Tyre Sheathed) Wiring System, have arranged with the proprietors of ELECTRICITY to offer a duplicate series of prizes for the three articles sent in by competitors in (*a*) the United Kingdom and (*b*) the British Colonies, which, in the opinion of the competition judge, or judges, most clearly and practically explain the advantages and disadvantages of the C.T.S. system for wiring and other purposes. The terms of the competition are as follows:—

1. The length of the article not to exceed about 1,000 words, or, say, two columns of ELECTRICITY, and to be written on one side of the paper only. Clearness of wording should be aimed at, and unnecessary flattery will be deemed a drawback.
2. Diagrams are not essential, and, if used at all, should be as few as possible, owing to the space limit.
3. There are no special restrictions as to competitors. The desire is to appeal to as wide a circle as possible, and for that reason the prizes will be in duplicate in order to enable colonial competitors to have an equal opportunity of expressing their views.
4. The papers sent in will be judged by Mr. W. E. Highfield, M.I.E.E., President N.A.S.E., and a member of the I.E.E. board of examiners, and no appeal can be made against the decisions arrived at.
5. The prizes offered are:—

First prize	Five Guineas.
Second prize	Three Guineas.
Third prize	Two Guineas.

and the St. Helens Company would at their discretion award consolation prizes up to one guinea each where they consider it suitable.

6. It is part of the contract that all competition papers, including the actual prize-winning papers, become the property of the St. Helens Cable and Rubber

Co., Ltd., and no application for their return can be considered.

7. Competition papers must be addressed to

"C.T.S." Competition,
ELECTRICITY Office,
36, Maiden Lane,
London, W.C.2,

and those from the U.K. must be delivered not later than the last post on January 31, 1924, while those from the Colonies must be delivered by March 31, 1924.

[*Competitors in the U.K. are requested to note the extension of time to January 31, 1924.*]

DIARIES, CALENDARS, ETC.

As usual, a wide range of artistic and attractive Marcus Ward wall calendars are on sale throughout the country. The series comprises a range of 24 at 2s. each and a range of 14 at 1s. 3d. In addition there are purse calendars, date cards, desk calendars, etc., in variety. The wall calendars each have delightful illustrations excellently reproduced in colour, and each day of the daily tear-off pad bears an appropriate quotation—from Shakespeare, Dickens, the poets, *Punch*, etc. Nor have the children been forgotten. The publishers, M'Caw, Stevenson and Orr, Ltd., of the Linen Hall Works, Belfast, and 329, High Holborn, London, W.C.2, are to be congratulated on the high tone of these productions, which at least equal, if they do not excel, their calendars of previous years.

We have also to acknowledge the kindly thoughts of many enterprising industrial undertakings who take advantage of the New Year to send their friends and customers useful gifts in the way of pocket books, diaries, blotting pads, etc., which serve during 1924 as reminders of the leading specialities of the various donors. The following is a brief list of some of those which have so far come to hand, viz.:—

A handsome aluminium-cased monthly calendar from the Reason Manufacturing Co., Ltd., of Brighton, who specialise in meters, time switches, etc.

A neat and beautifully bound pocket diary from the General Electric Co., Ltd. The name of our editor was neatly printed thereon in gilt letters, and he promptly pocketed it to replace the similar diary which had proved an invaluable friend during 1923.

Messrs. Robert Hornby and Co., Ltd., the meter specialists, have sent a well-made season-ticket wallet and card case, which was put into immediate use. We expect it will see plenty of service.

The usual refill for the Sunco desk calendar has made its appearance, and on a desk in this office will serve to remind us of the business activities of the Sun Electrical Co., Ltd., during the ensuing twelve months.

The pocket diary for 1924 which has been sent to the numerous friends of Siemens Bros. and Co., Ltd., of North Woolwich, is the same convenient pattern as they have issued for some years past, and contains many useful electrical tables.

The Chloride daily desk calendar was alloted even before it came to hand. When received it was given the usual welcome as a business asset of direct value and convenience equivalent to the reputation which the Chloride Storage Battery holds in all parts of the world.

From the "At-a-Glance" Calendar Co., Ltd., of Finsbury Pavement House, London, E.C.2, we have received specimens of various types and sizes of these eminently serviceable and distinct calendars, which they can supply in all sorts of sizes and shapes duly overprinted to suit the fancy of those enterprising firms which make use of what is, after all, one of the most efficient forms of advertising from an "everyday" point of view. They should, therefore, appeal to a wide circle of manufacturers, contractors, etc., especially when it is remembered that nowadays it is often customary to issue calendars which run from one year into the next, and so on. Write them for list 124A.

The "Pilot" calendar, as issued and sold by the Pilot Manufacturing Co., Ltd., of 9 and 10, Mallow Street, London, E.C.1, is of the daily turn-over, memo-tablet type, mounted on a neat varnished wood base, with adjustable back, pen tray, etc., which has proved of such value to business men during the last few years. It can therefore be recommended for regular use in both office and home, and the makers will be pleased to quote prices for the various types which they now have on the market.

We are in receipt of a "New Ring" tablet diary from John Gibson, 63, Coleman Street, E.C.4. This diary is for use over a period of 15 months and gives instant reference to past and present jottings. It is neat and, at the low price of 1s. 6d., is remarkably cheap.

The Liverpool Marine and General Insurance Co., Ltd., of 7, Angel Court, London, E.C.2, are presenting to their friends and customers a very neat vest-pocket diary, which will help to remind the recipients that the company specialise in wireless insurance policies and wish to appoint real live agents all over the kingdom.

Answers to Correspondents.

A. C. WARNER (R.A.F. Power House Staff).—The reply to your question concerning the insulation of Vee rings will be published under the replies to Question No. 171 of our Questions and Answers Competition.

A. B. COURTAULD (Didsbury).—The article on Armature Winding, by Mr. C. Sylvester, A.M.I.E.E., A.M.I.Mech.E., will most probably be published next week.

Lecture.—A lecture entitled "Present-day Practice for Bare Overhead Line Construction, Medium and Low Pressure" (with lantern illustrations), will be given by Mr. S. Austen Stigant, M.I.E.E., before the members of the National Association of Supervising Electricians at St. Bride's Institute, Bride Lane, Ludgate Circus, E.C.4, on Tuesday, the 8th inst., at 7 p.m.

Questions and Answers by Practical Men.

RULES.

QUESTIONS : *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS : *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

Commencing with Question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 173.

I am employed on railway signalling, and I do not understand the construction and principles of operation of the following:—

(1) Track relays, galvanometer type.
(2) Track relays, vane type.
(3) Detection relays, polarised vane type.
(4) Purpose of shading bands on latter.

I would appreciate the details of operation, etc. The tracks are single-phase, 25 to $33\frac{1}{2}$ cycles.—"JACK ALLEN."

QUESTION NO. 174.

Can any reader inform me of the process by which accumulators are treated to enable them to be put on the market in what is known as "a dry and fully charged condition," i.e., only requiring to be filled with dilute acid and to be given a short freshening charge?—"C. R. HARDY."

(Replies to Questions Nos. 173 and 174 must be received not later than January 5, 1924.)

Answers to Questions.

QUESTION NO. 169.

The second prize (5s.) has been awarded to "M.M." for the following reply:—

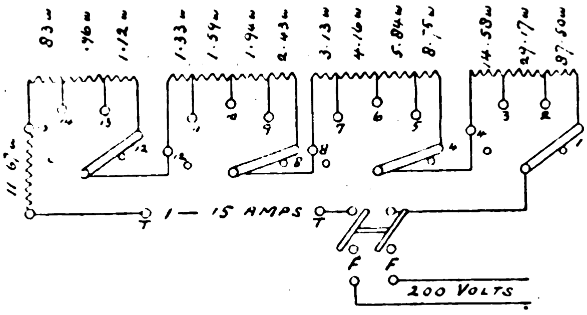
To reduce the 200 volts to 25 volts and then, with the working potential still 25 volts, to take various values of current requires some speical arrangement.

The better way would be to employ a suitably wound motor-generator. Or again, a liquid resistance would be at once cheaper and would also give a finer grade of adjustment.

The following is, however, suggested as a method of arranging a wire resistance for the purpose required. It is not claimed for this arrangement that it is much more than an approximation, and provision is only made for definite currents of from one to fifteen amperes. Should more exact conditions be requisite, there will be little difficulty in making the necessary alterations and additions.

The accompanying sketch illustrates the arrangement. There are four sets of coils, each set being supplied with a switch. These sets could be fitted on four frames. Values of the resistances are marked for each division in ohms—from 11.67–87.5. The figures against the contact studs of the switches indicate the current to be taken at 25 volts. As shown, it will be seen that the total resistance—175 ohms—is in circuit. With a current of 1 ampere, 175 ohms is required as the drop in the load will $=1 \times 25 = 25$.

The remaining voltage $= 200—25 = 175$.



Thus the 200 volts of the supply are accounted for. Now suppose the four switches are all turned to the last contact on the left. In that case only the fixed resistance of 11.67 ohms is in circuit. There would then only be 25 volts at the terminals if a load taking 15 amperes were connected.

$$\text{We have } R = \frac{E}{I} = \frac{200—25}{15} = 11.6.$$

Suppose 9 amperes are required. Tune switch lever to contact marked 9, the left-hand switch to contact 12 and the remaining two to 4 and 8 respectively. There will then be 19.44 ohms resistance in circuit with a current flowing through resistance and load of 9 amperes.

$$\frac{175}{9} = 19.44$$

Volts across the load = 25.

It will be noticed that there are two contact studs for each of the numbers 4, 8 and 12. This is because there is not any resistance between these several pairs of studs.

As regards the wire employed for the resistance coils, Eureka will be found suitable for the purpose. For the fixed resistance of 11.7 ohms, 147 yards of No. 12. Other coils of proportionate sizes and resistances, obtainable from any electrical engineering pocket-book.

Note that with *one* ampere, all the resistance coils are in circuit ; with *fifteen* amperes only the fixed resistance is employed.

T.T. are terminals ; s.s.s.s. stops for switch levers.—"M.M."

NOTE.—The replies to Question No. 169 were of such a high standard that there was considerable difficulty in judging them. Under these circumstances it has been decided to award two second prizes, but pressure on our space prevents us publishing the remaining answer until next issue.

Tenders Accepted.—The G.W. Ry. Co. have accepted the tender of the General Electric Co., Ltd., for the supply of Gasfilled Lamps for 12 months from December 1st, 1923, to November 30th, 1924.——The Booth Steamship Co. have accepted the tender of the Siemens and English Electric Lamp Co., Ltd., for the supply of Electric Lamps for the 12 months commencing January 1st, 1924.——The Siemens and English Electric Lamp Co., Ltd., announce that the Royal Mail Steam Packet Co. have accepted their tender for the supply of Metal Filament Lamps for the 12 months commencing January 1st, 1924. Also that the L. and N.E.R. (Great Central Section) have accepted their tender for the same period for the supply of Enamelled Iron Shades and various items of Siemens Gasfilled Lamps.

V.I.R. CABLES—THEIR MANUFACTURE AND SELECTION.*

(Continued from page 691.)

The Selection of V.I.R. Cables.—How the contractor is to select his cable is still a more or less difficult question to answer in any concise form. To have any real practical value it is essential that the tests he adopts should be simple in character and easy of attainment. Any elaborate analysis or chemical tests are impracticable, and in addition are more or less valueless to the contractor, as such tests would simply determine the causes of the defects, whereas he is primarily concerned to see that the effects themselves have been attained by the manufacturer.

Physical tests, therefore, are pre-eminently the tests for the contractor to adopt, and the behaviour of the cable under dry or moist heats, under the stretching tests and the electrical tests for di-electric strength and insulation resistance, will enable him to judge whether the cable is likely to give satisfaction for a reasonable length of time under working conditions.

What might be described as simple visual tests will convey a rough idea of the value, but only if this is done by one having had the good fortune to be familiar with a high standard of workmanship in this class.

The simplest "tests" of a V.I.R. cable are to examine the details of a finished product itself, starting from the outside coverings and working inward to the conductor; this being exactly opposite to manufacture, which begins at the conductor and builds up to the outside covering.

(1) *The Braiding.*—The cable should show that the outer surface is smooth and uniform—the compounding should be an even coating, not sticky to touch, but having a surface which will slip easily when drawing the cable into ducts or conduit. Any excess of compound is usually removed at bends, where it is least wanted, and soon makes the drawing in a more difficult matter.

Now cut through the braiding only and lay it open. The compounding should penetrate right through the thickness of the braiding, to ensure that the fibrous material, of which it is composed, is thoroughly impregnated with this preservative.

These two essentials are possible only when the cable has been passed through the bath of compound at a correct speed and when the compound itself is at a correct temperature, any attempt to speed up the run will result in defective compounding.

(2) *The Tape.*—The tape should be finely woven, thin, but of considerable strength, and applied so that it adheres firmly and evenly to the insulation.

(3) *The Insulating Coverings.*—(*a*) The overall diameter should conform to the thickness specified.

(*b*) The section of the V.I.R. should be uniform, or, in other words, the conductor should be exactly in the centre of the insulating coverings. This I consider a very important feature.

(*c*) The longitudinal seam on each side of the circumference should show no signs of opening, as the two edges coalesce in the process of vulcanisation. The presence of any foreign matter on the V.I.R. strips at the time of manufacture might prevent this taking place during vulcanisation, and is a serious defect in manufacture.

(*d*) The insulation should not "furr" when the cable is drawn through the fingers—this you will practically always find does take place in low-grade V.I.R. cables, but I have not known it do so with high-grade makes.

(*e*) With some practice a rough idea of the degree of vulcanisation can be ascertained from the feel of the hardness or the softness of the rubber coatings, but, it must be admitted that such examination can be relied upon only after a considerable amount of experience. For instance, under-vulcanised V.I.R. coatings, *when new*, usually show greater ease in stretching, and might lead one to suppose that it is a very good quality, whereas the same material in a few months' time would show the softening and tackiness resulting from under-curing.

(*f*) In the highest-grade cables it is impossible to detach the rubber strip from the vulcanised coatings; the lower the grade the easier this can be done. In addition, the rubber strip should be free from any blemish or small punctures, which appear in lower grades especially after a short lapse of time. The best strip is of a clear amber tint, and should have no sign of blackening.

(4) The conductor should be bright and clear—I need hardly say this to those familiar with what a tinned surface is.

These tests are simple, but the cumulative effect of them is that they are evidence of good and careful workmanship, and, at the least, indicate the intrinsic value in the material. They are not meant to be conclusive, or that the cable will meet the three all-important conditions required in all wiring installation work, viz.:—

(*a*) That the insulation will not deteriorate with time.

(*b*) That the insulation will withstand the conditions under which it is to operate, embodying insulation resistance and di-electric strength.

(*c*) That the cable will not easily be damaged by handling during erection.

(To be continued.)

---

* Lecture delivered by William Lang, M.I.E.E., before the National Assoc. of Supervising Electricians, November 13, 1923.

Plant Wanted.—The Municipal Council of Johannesburg invite tenders for the supply of electric meters and time switches. Specification is available for inspection at the D.O.T. (Room 52), 35, Old Queen Street, London, S.W.1.

New Zealand.—A report on the commercial conditions in this Dominion has just recently been issued by the Department of Overseas Trade, and may be obtained from H.M. Stationery Office or *Electricity* office, price 2s 3d. net, post free. It contains various sections of interest to manufacturers and exporters of electrical goods, including details of the hydro-electric development, which is now making such progress in this go-ahead colony.

Ideal.—The New Year is a time when one makes splendid resolutions. The writer of these lines has most certainly made one resolution which he will do his best to keep, viz., to continue to use the Waterman "Ideal" fountain-pen which has been his faithful friend for a long series of years. A good pen is an invaluable asset to any journalist, and he feels quite lost if it should happen to be mislaid or damaged, although he knows full well that in the latter case the makers are always ready to carry out any necessary repairs. The moral, therefore, of this paragraph is that if you are not already the happy owner of an "Ideal" fountain-pen the best thing is to make yourself a present of one without delay.

Reviews of Books, &c.

[Books noticed in this column will be sent from ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

MECHANICAL WORLD YEAR BOOK, 1924. (Emmott, 1s. 6d. net).—The 37th edition of this eminently practical and popular pocket book has just been published, and is in keeping with the high standard always set by its inceptors. For the draughtsman, student, works manager, or any engineer, designing, controlling or manufacturing, it is of the greatest assistance, going just that step beyond simple facts which prevent it from becoming too theoretical and thus frustrating its purpose.

This year additional sections have been added on the combustion of fuel (a most important point with the ever-increasing desire to reduce coal consumption), air required for combustion, and the calorific values of fuels.

The tables are most complete, and if appreciated properly by the user, can save infinite drudgery in calculations. The junior draughtsman should find it particularly useful.

Trade Notes.

A new design of 6,600 volts, three-phase switch-gear for current up to 250 amperes has just recently been produced by **Messrs. George Ellison**, the well-known makers of control gear, of Perry Barr, Birmingham. The photos which we have before us show an installation of this switch-gear in the Northfield Sub-station of the Birmingham Electric Supply Dept., and when the details and illustrations are reprinted in pamphlet form they should prove of direct interest to all central-station engineers as well as to contractors for the installation of switch-gear, whether in Great Britain or in the Colonies.

A new list issued by the **B.T.-H. Co. Ltd.**, from 77, Upper Thames Street, deals with the beautiful lighting effects which may be obtained with the "Luxor" unit fittings, described at length on page 655 of our issue of December 7th last. Contractors and retailers who have not had a copy should write for it at once.

A well-illustrated catalogue, No. 93, of electric fires and cookers has just been issued by the **Siemens and English Electric Lamp Co., Ltd.**, of 39, Upper Thames Street, E.C.4. It contains prices and details of many very attractive and economic types for domestic use, and should prove of value to all electrical contractors who are pushing the sale of these goods.

A new catalogue of the books published by the **University Tutorial Press, Ltd.**, has just come to hand. Several of the works included therein are standards in connection with electrical science, and as such are known to many of our readers. The list is accompanied by a schedule of reduction in prices, which takes effect from January 1st, 1924.

150 Motor Ships on Order.—According to this month's *Motor Ship*, there are now orders in hand throughout the world for 150 oil-engined vessels, including cargo ships of more than a million tons deadweight, and passenger liners totalling about 144,000 tons gross. Of these vessels, about 60 are under construction, or will be laid down in British yards.

Preston.—The Electricity Committee have decided to adopt "the two-part" tariff system so as to encourage the use of current by householders. The charges will be based on 20 per cent. of the rateable value with a supply of electricity at 1d. per unit. It is estimated that in a house of the rateable value of £30 the service charge will be approximately £6 per year, and current for cooking, heating and lighting will run about 6s. per week.

Various Items.

Lytham.—The consumers of electricity in Lytham and St. Annes number 4,393, an increase of 653 during the year.

Burnley.—The Electricity Committee propose to reduce current for heating and domestic purposes from 2d. to 1½d. per unit.

E.D.A. Sales Conferences.—The next conference will be held on Friday, January 18th, at the London School of Economics, at 7.30 p.m., when a paper will be read by Mr. C. G. Nobbs on "How to Market Hot Water for Domestic and Heating Purposes," Mr. J. H. Bowden in the chair.

Earlier Publishing.—Our esteemed contemporary, the *Electrical Review*, will in future be published on Friday mornings instead of on Saturday mornings as has been the custom for some time past. We congratulate them heartily on what we consider a very wise move.

Social.—The M.E.M. Social and Athletic Club, an active organisation in connection with the works of the Midland Electric Manufacturing Co., Ltd., held their annual Christmas dinner and concert last week at the White Horse Hotel, Birmingham, Mr. W. L. Barber presiding. Nearly 160 members of the works and office staff were present. An excellent musical programme was provided by members.

Plant Wanted.—The Copenhagen Lighting Dept. invite tenders for the supply of one turbo-generator plant and accessories.——The Municipal Council of Sydney invite tenders for the supply and delivery of transformers.——The Copenhagen Lighting Department invite tenders for transformer plant. Specification and conditions available at the D.O.T. (Room 52), 35, Old Queen Street, Westminster, S.W.1.

Catalogues Wanted.—The Acting British Consul-General at Havana reports that Cuba constitutes an abnormally large market for radio apparatus in proportion to its population. The present chief source of supply is the United States of America. Competition, however, is a matter of price only, and the market warrants investigation by United Kingdom producers. He states that catalogues containing current quotations would prove useful in determining the actual extent of the scope offered to U.K. competitors in that market. Firms interested in the matter should forward catalogues, etc., to the Acting British Consul-General, British Legation, Havana, Cuba.

Meetings.—The I.E.E. will hold a joint meeting with the Societe des Ingenieurs Civils de France (British Section), in the Lecture Theatre of the Institution, on Thursday, 10th inst., at 6 p.m. Continuation of discussion on Monsieur A. Bachellery's paper on "The Electrification of the Midi Railway."——The Junior Inst. of Engineers will meet on Friday, 4th inst. Lecturette: "Economy of Fuel by Removal of Soot from Boiler Tubes," by L. Manico. On Tuesday 8th inst, there will be a dance at the Cannon St. Hotel, at 7 o'clock. On Friday, 11th inst, paper, "Concrete Engineering," by C. O. Mourant. On Wednesday, 16th inst. at the Royal Society of Arts, John St., Adelphi, at 7.30, presidential address by Sir J. Fortescue Flannery, Bart., on "Marine Propulsion During Fifty Years." And on Friday, 18th inst., lecturette: "The Liability of Employers in Respect of Personal Injuries to Their Workmen," by G. F. Taylor.

The House of Springer.—Recently we had the pleasure of being present at the opening of "The House of Springer," and, while it may be truly said that it is not mortal to command success, if any enterprise associated with the cinematograph industry deserves it, it is certainly the house of J. Springer, Ltd., who have opened new and magnificent showrooms at 152-158, Wardour Street. The most casual passer-by is arrested by the gorgeous display of novel and attractive illuminated specialities that serve to mark the new showrooms. The beautiful art-mosaic bowls, shades, panels, windows and signs afford a variety of colour and design almost impossible of description. Any design, exclusive to the customer, can be made at short notice in the firm's own studios at prices which will be found favourable upon comparison with the ordinary material offered for decorative purposes. We were extremely interested in a new design of arc lamp for studio lighting. There is ample scope for the development of this class of lighting, since the usual batteries of mercury vapour lamps are not only expensive but are not the acme of efficiency. Anyone and everyone interested in the cinema would do well to visit the showrooms of J. Springer, Ltd.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
A PRACTICAL TRADE JOURNAL

JANUARY 11, 1924.

CONTENTS. PAGE

Vital Factors in Workshop Efficiency 15
Relations between Torque, Current and Speed in a Motor .. 16
Problems in Telephony, Solved and Unsolved 17
Current Topics 21
V.I.R. Cables : Their Manufacture and Selection 22
A New " Geophone " Amplifier 23
Lighting Designs for Shops and Stores 23
Crompton-Robertson Bridge Potentiometer 24
Questions and Answers by Practical men 24
Reviews of Books 24
Various Items 26

VITAL FACTORS IN WORKSHOP EFFICIENCY.

While deploring the high working costs and the relatively low production, how many managers consider the contribution of the workshop itself to this undesirable state of affairs? Judging by the number of ramshackle, tumbledown, dingy, dilapidated and unprepossessing buildings situated in most of our large industrial centres labelled "Factory" by their enthusiastic owners or tenants, it would seem that many, at all events, are indisposed to recognise the culpability of the workshop itself. Yet, apart from direct expense in the form of upkeep, rent, rates, taxes and the like, the factory has a decided influence upon the working costs. The unhealthy and insanitary workshop will attract only the lowest grade of labour, or, if a higher grade of labour is an absolute necessity to the business, then inducements in the form of high wages must be offered.

In either case the working costs are disproportionate to the output, for the wages paid are not really earned. Part of the wages paid is in the nature of a bribe, and has no earning power, for, if the district rate is, say, one shilling per hour, and in order to get suitable labour fifteenpence per hour must be offered, the shilling may possibly yield an adequate return, but there is no return for the extra threepence, this being a direct charge against production to ensure the presence of the workman.

If the firm is not prepared to offer the higher wage it must be content with a lower grade of labour, but here, again, productive capacity is reduced. The firm may succeed in keeping the charges upon the building fairly low, but the inside charges are much higher than they should be.

Such a factory, too, must affect the *morale* of the workman, and the higher wages paid add to the demoralising influences that abound. The workman, attracted by the wage, is readily obtainable, and he enters the building fully confident that the offer is a tribute to his ability, and that the appointment is a further step along the path of progress. He doubtless is ambitious, and his potential capabilities are awaiting an opportunity to develop; but, alas! once inside the building, that development does not materialise, because the opportunity is lacking.

He chafes at the restrictions imposed by the conditions prevailing, and sets out with a determination to surmount all obstacles, not realising that they are quite insurmountable. He throws himself against the barrier, but he cannot break it down, and, bruised and sick at heart, he in a short time accepts the inevitable, and his future demeanour is one of sullen acquiescence.

No flight of fancy this, but a stern reality, for many a promising career has been sacrificed to the gold-tipped but demoralising present. The pay becomes all that matters, and, when this is forthcoming without an undue expenditure of labour and energy, why go farther and possibly fare worse? This is the attitude usually adopted, and it is in but very few instances that the individual breaks free and goes elsewhere to allow the potential capabilities to develop.

And, apart from this, how can enthusiasm be kindled in depressing surroundings, when the health of the worker is adversely affected by the conditions under which he labours? Truth to tell, he never feels well enough to put his whole heart into the job, and yet the manufacturer complains bitterly of the "ca'canny" methods he adopts. The workman is not to be blamed in such circumstances, for his mental and physical senses are dulled by the drab and colourless conditions that abound.

The factory, instead of stimulating interest, casts a blight over all employed therein, from the manager downwards, and real efficiency is impossible. It may no doubt be possible to get what is considered a high return from the factory, and this might be termed efficiency, but, taking into consideration the cost, the "efficiency" is of low degree.

To ensure real efficiency, the workshop itself must render good service, and it is a mistake to assume that the building itself does not matter. The manufacturer uses a building because his product must be shielded from the elements, and to render more fruitful the labours of his workpeople. This being so, it is surely the height of folly to allow the building to become dilapidated, leaky, draughty and insanitary, inflicting injury upon the material and the health of the workers. The manufacturer asks for efficient service, but can he hope to get it when the atmosphere of the workshop is sapping the vitality of those who work therein? The building must be such as will lend itself to the efforts of those who would make improvements, and those efforts must be engendered by the knowledge that possibilities exist and can be developed.

Another factor is the workman himself, and how he fits in with the scheme of things. Assuming that the building passes the test, the next thing to consider is the real effective value of every individual employed therein, and it is only in comparatively few concerns that this factor is frankly recognised.

So, here is the workman, and he offers his labour in return for a wage. Before this is accepted, the manufacturer must decide that the labour will be worth the wage, and that it can be utilised in such a way as to be a paying proposition. The engagement is in the nature of an experiment, and, if the applicant can produce references from his previous employers, these no doubt help the prospective employer to form a fairly accurate estimate of his capabilities; but they must not be taken too literally. Because a man has achieved a certain measure of success elsewhere, it does not of necessity follow that that success will continue in his new sphere of action, for the precise conditions under which he laboured elsewhere are not known. So long as his general character is good, and tribute is paid to his willingness, adaptability and attention to business, there is not a very big risk in deciding to experiment.

If the workman is justly considered and given every opportunity for development, every position, from the lowest to the highest, will be held by an efficient person, and, no matter how humble may be the position, efficiency raises its dignity and, incidentally, its value. There may not be any truth in the saying that there is a "field marshal's baton in every private's knapsack," but there is no reason whatever why the man in a humble position should not aspire to become a works manager. The chances are that his aspirations will not fully materialise, but the endeavour will most certainly improve his status, and will just as surely increase his value in the eyes of his employer.

If the man is proficient in one capacity, it is a mistake to allow him to remain there, for there is a reserve of energy and ingenuity lying dormant. He probably does not know this, but he does know that he can perform his task without an excess of effort, and his chief should know this also. And, when this point is reached, it is unfair to the man, to the man beneath him, and to the employer, to deny him the opportunity for rising higher. If the higher officials are efficient, there is nothing gained by superseding them, but the rise may be effected by raising the standard of efficiency, which would be of advantage to the workman and to the manufacturer.

The workman is affected by his environment. If his working conditions are stimulating, they will bring out the best that is in him; if they are depressing, they will force even natural ability to a lower level. The efficiency of the individual must either expand or contract, for it cannot remain quiescent, and the same remark applies to the collective efficiency of the workshop, seeing that it is based upon that of the individual worker and governed by the conditions prevailing.

RELATIONS BETWEEN TORQUE, CURRENT AND SPEED IN A MOTOR.

The torque of a motor is the turning effort which it exerts, and its magnitude will be determined by the size of the armature. It is also proportional to the armature current and field strength. In engineering units, it is expressed in pound-feet, for instance, if we had a belt hanging over a pulley which rotates in a horizontal plane, with weights of, say, 90 lb. and 70 lb. at each end of the belt, and the pulley had a radius of 2 feet, then the measure of the torque is $(90-70)\,2 = 40$ lb.-ft.

When expressed in dyne-centimetre units, the value becomes $(90-70)\,454 \times 981 \times 2 \times 30.5 = 543 \times 10^6$ dyne-centimetres, the corresponding conversion value being 30.5 cm. = 1 foot, 454 grams = 1 lb., and 981 representing 32.2, the value of the acceleration due to gravity.

To convert torque (lb.-ft.) into work (ft.-lb.) we multiply the former by 2π per revolution of the armature, and by $2\pi N$ for N revolutions, this is arrived at by remembering that $2\pi R$ is the armature circumference, R being already in the expression under torque. If N be the number of revolutions per minute, then the h.p. developed is

$$\frac{\text{Torque} \times 2\pi N}{33{,}000} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (i)$$

From electrical considerations, we can also find the h.p. developed, thus, if E and e be the applied and back e.m.f. respectively, and C the armature current, then

$$\begin{aligned} \text{watts supplied} &= EC \\ \text{watts wasted} &= (E-e)\,C \\ \text{and watts available} &= eC \\ \text{Therefore h.p.} &= \frac{eC}{746} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (ii.) \end{aligned}$$

Equating (*i.*) and (*ii.*) we have

$$\frac{eC}{746} = \frac{\text{Torque} \times 2\pi N}{33{,}000}$$

$$\text{from which Torque} = \frac{33{,}000 \times e}{746 \times 2 \times \pi \times N} \times C$$

$$\text{The back e.m.f. } (e) \text{ is} = \frac{FNZ}{10^8 \times 60} \text{ where}$$

F = flux passing through the armature,
Z = number of conductors,
N = revolutions per minute,

and, putting this expression for e, the equation becomes

$$\text{Torque} = \frac{33{,}000 \times FNZ \times C}{746 \times 2\pi N \times 10^8 \times 60} = \frac{FZC}{8.52 \times 10^8} \text{ lb.-ft.}$$

being, therefore, directly proportional to the flux, the number of conductors and the armature current.

A useful way of showing the relation between total power, useful power and power wasted in a motor is by using the fundamental equation

$$C = \frac{E-e}{R}$$

$$\begin{aligned} \text{multiply by } R\text{, then } CR &= E-e \\ \text{multiply by } C\text{, then } C^2R &= EC-eC \\ \text{transposing } EC &= C^2R+eC \end{aligned}$$

EC being watts supplied to the motor, C^2R the watts wasted, and eC the watts usefully employed, and for the efficiency of the motor $\frac{eC}{EC}$ or $\frac{e}{E}$

Taking extreme cases when $e = E$ we should have a 100 per cent. machine, but taking no current, as $C = \frac{0}{R}$; this would be interpreted as at very great speed, and doing infinitely little work at maximum efficiency.

Again, when e is o, it is taking maximum current, but the h.p. will be zero, viz.: $\frac{eC}{746} = \frac{o}{746}$

The greatest rate of doing useful work is reached when the speed is such that $e = \frac{1}{2}E$, or at a motor efficiency of 50 per cent., though in practice motors are designed such that the back e.m.f. is from 85 to 90 per cent. of the applied e.m.f.

Motor Losses.—These are broadly divisible into three classes:

(1) Variable losses.
(2) Constant losses.
(3) Frictional losses.

In class 1, the greater the load, the greater the armature current, and as such losses in watts are given as C^2R, they will be proportional to the square of the armature current.

Frictional losses are proportional to the speed and may be given as h.p. lost $= \dfrac{\textit{frictional torque} \times 2\pi N.}{33{,}000}$

The constant losses are those occurring in the shunt field and iron core. All these electrical losses are due to the heating of the armature and field coils, hysteresis losses and eddy currents in the iron core and pole pieces.

Speed regulation.—Suppose we have a motor running at a constant speed with a certain load. If now more load be put on the motor, there will be a greater torque and more current required, and the speed will fall, this reduces the back e.m.f., and therefore a larger armature current flows, thus increasing the torque. To maintain this speed at the new load, we must reduce the back e.m.f. by weakening the field. Again, if the load is reduced, the torque will be too large, and the speed will rise, this increases the back e.m.f. and cuts down the armature current so that the torque again adapts itself to the load. For this speed to be constant at the lighter load, the back e.m.f. is increased by strengthening the field.

In the case of a shunt or compound machine a rheostat is put in the winding, as its resistance rises so the field weakens and the speed increases, by reducing the rheostat resistance the field strengthens and the speed falls. In a series motor the rheostat is put in parallel to the series field coils.

PROBLEMS IN TELEPHONY, SOLVED AND UNSOLVED.*

BY PROFESSOR J. A. FLEMING, M.A., D.Sc., F.R.S.

(*Continued from page* 696, Vol. xxxvii.)

(7) In correlation with this part of the subject it would be interesting to discuss theories of hearing, especially the manner in which the ear performs a sort of instantaneous Fourier analysis of complex airwave forms, appreciating the harmonics present with the fundamental tone, and not only their relative amplitude but, to some extent, their phase differences. Time, however, forbids anything but a brief reference to two well-known theories. There is in the internal chamber of the ear a spiral tube called the cochlea, and in this tube is contained an organ called Corti's organ. This comprises a vast number of fibres, some say as many as 16,000. According to a theory put forward by von Helmholtz in 1863, and modified by Gray, Corti's organ may be regarded as a microscopic harp of 10,000 strings, each of which is tuned to resonate to a particular rate of vibration. It is therefore supposed to pick out and respond to the impulses due to the corresponding harmonic frequency in a sound wave just as certain strings of a piano can be set in vibration by a clear note sung into it by a powerful singer. This theory, though widely accepted, has, however, been opposed by some biologists and in particular the late Sir Thomas Wrightson, who propounded another view in 1873 which he elaborated in a book published in 1918 entitled "The Mechanism of the Internal Ear." In a lecture given at the Royal Institution, London, in March, 1919,* the eminent physiologist, Sir Arthur Keith, expounded this latter theory and explained that by Sir Thomas Wrightson's hypothesis the organ of Corti does not act as a resonator at all, as supposed by Helmholtz, but is an extraordinarily sensitive pressure gauge which registers and appreciates minute and rapid changes of pressure applied to the fluid in the cochlea by the sound waves. It appreciates not only the frequency of these pressure-changes and their amplitude, but also the manner in which the pressure alters during a single cycle of operations.

The nerve fibres in the Corti organ convey this information to the brain centres of audition, where they are translated into sensations of sound, with its three distinctive qualities of pitch, loudness and quality.

If we call to mind the very distinctive qualities of individual human voices, even when pronouncing the same words, and the manner in which these tones can express emotions, feelings, or personality, all of which must be represented physically by minute differences in wave-form, we realise that the human ear is indeed one of the marvels of creation in its amazing powers.

V.—THE TELEPHONE CONSIDERED AS AN ENERGY-TRANSLATING APPLIANCE.

(8) When we consider the very complicated nature of our vocal or speech organs, as well as the training and practice necessary for their efficient use, and the parts played by the larynx, oral cavity, lips, tongue and teeth in speaking, we find reason for great surprise that the mere vibrations of a small flexible disc such as the iron diaphragm of a Bell receiver can impress upon the air, vibrations of the highy irregular wave-form necessary to reproduce speech sounds. When a thin, flexible disc is held firmly at the edges it can only vibrate in certain ways in consequence of elastic stretching, and it has, like a stretched string, a fundamental mode of vibration in which it takes a convex or concave form as a whole and also certain harmonic modes of vibrating in sections. In the case of a circular flexible disc of radius r, thickness t, made of material of density d, Young's modulus e and Poisson ratio q, Lord Rayleigh gave† the following formula for the fundamental rate of vibration n of a circular disc clamped all round the edge:—

$$n = \frac{2.56 t\sqrt{e}}{\pi r^2 \sqrt{(3d)}\sqrt{(1-q^2)}} \quad . \quad . \quad . \quad . \quad (17)$$

The Poisson ratio q is the ratio of the lateral contraction to longitudinal extension of an elastic material when stretched. Its numerical value for steel is about 0.31, so that $\sqrt{(1-q^2)}$ is nearly 0.95 or not far from unity. Hence, approximately,

$$n = 1.48 \frac{t}{\pi r^2} \sqrt{\left(\frac{e}{d}\right)} \quad . \quad . \quad . \quad . \quad . \quad (18)$$

But $\sqrt{(e/d)}$ is the velocity of sound in the material. We have therefore this very simple rule, that the fundamental frequency of vibration of a circular diaphragm clamped all round the edge is nearly equal to 1½ times the ratio of its thickness to its area, multiplied by the velocity of sound in the material.

---

* Lecture delivered before the Institution of Electrical Engineers, to whom we are indebted for the illustrations.

* See *Proceedings of the Royal Institute of Great Britain*, 1919, vol. 22, part 3, p. 508.

† See "Treatise on Sound," vol. 1, 2nd ed., p. 367.

The diaphragms of Bell receivers are usually made of thin low-hysteretic steel such as that called "Stalloy" containing 2.75 per cent. of silicon, and are about 5.0 cm in effective diameter and 0.025 cm thick. The ratio of thickness to area is then 1 : 785.

The velocity of sound in steel is about 4,710 metres per second, and hence the natural frequencies of the diaphragm by the above formula should not be far from 942 p.p.s.

For a steel circular steel diaphragm of thickness t and diameter d cm the above rule approximates to 900,000 t/d^2. Hence for a diaphragm 1/40 cm thick and 5 cm in diameter it gives $n = 900$.

These dimensions have been arrived at by trial and give a frequency not far from 800 p.p.s., which is generally taken as a kind of mean frequency for speech waves.

(9) In a paper* published in 1912 by A. E. Kennelly and G. W. Pierce, it was shown that there are four constants of a telephone receiver which determine its performance throughout the frequency range of ordinary telephony, viz. 100 to 2,500 p.p.s. These are: (1) The *force-factor* (A) or electromagnetic pull on the diaphragm in dynes per absolute C.G.S. unit of current in the coils; (2) the *equivalent mass* (m) of the diaphragm or a mass which, moving with the velocity of the centre of the diaphragm, has the same kinetic energy as the whole diaphragm; (3) the *motional resistance* (r) of the diaphragm, in dynes per unit of velocity referred to the motion of the equivalent mass; and (4) the *stiffness constant* (s) or force in dynes per unit displacement in cm opposing the movement of the diaphragm and referred to the equivalent mass at the centre.

In the above-mentioned paper Kennelly and Pierce showed that valuable help could be derived in determining these receiver constants from a diagram called the *motional impedance circle* of the instrument.

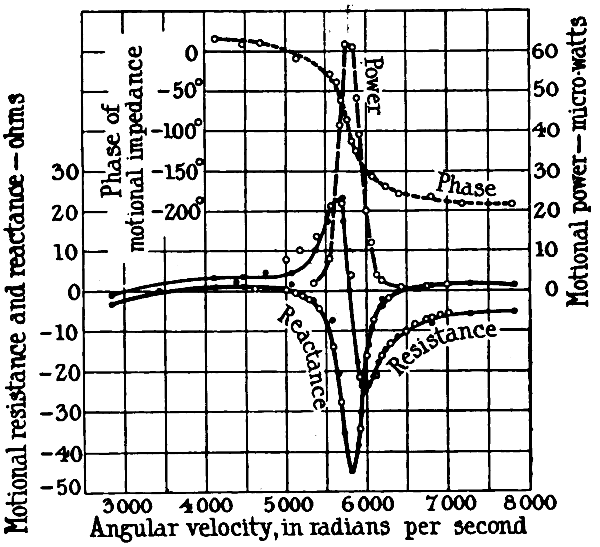


FIG. 3.—CURVES SHOWING THE MOTIONAL RESISTANCE, REACTANCE, AND POWER FOR A BELL TELEPHONE RECEIVER, PLOTTED IN TERMS OF ANGULAR VELOCITY OR 2π TIMES THE FREQUENCY (KENNELLY AND PIERCE).

If we measure with a suitable bridge arrangement the resistance and reactance of the telephone coils with alternating current of known frequency and pure sine wave-form, both when the diaphragm is freely vibrating and also when it is held fixed or damped, we find differences between these free and fixed values which are called respectively the *motional resistance* and *motional reactance*.

If we plot the above differences as ordinates in terms of the angular velocity of the current or of 2π times the frequency $= 2\pi n = \omega$, we obtain curves as shown in Fig. 3. The motional resistance rises with the frequency to a maximum and then falls quickly through zero to a negative maximum. The motional reactance is mostly negative and has a maximum nearly coinciding with the resonance frequency of the diaphragm, at which frequency the power absorption of the receiver is a maximum also.

If we plot the motional resistance horizontally as abscissæ and the motional reactance vertically as ordinates, we obtain as graph a circle called the *motional impedance circle*, and this passes through the origin. The diameter of this circle is depressed below the horizontal by an angle called the *depression angle* (see Fig. 4). The chords of this circle drawn through the origin give the vector impedance of the telephone for the corresponding frequency. The diameter of this circle drawn through the origin gives the motional impedance of the telephone at resonance. It was pointed out by Kennelly and Pierce in 1912 that from an inspection of this motional impedance circle it is possible to obtain data which assist in giving the value of the four principal constants when combined with one other measurement. Kennelly and Affel showed* in 1915 that if we measure the amplitude of vibration of the diaphragm at its centre, produced by a sinusoidal alternating current through the coils of the telephone, we can find by the aid of this measurement and the motional impedance circle all four characteristic quantities of the receiver.

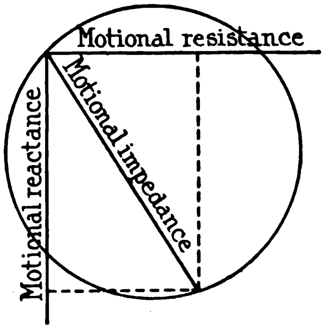


FIG. 4.—MOTIONAL IMPEDANCE CIRCLE OF A BELL TELEPHONE RECEIVER (KENNELLY AND PIERCE).

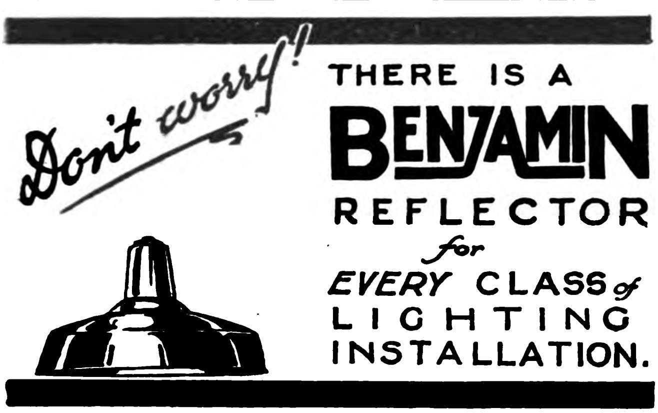
(To be continued.)

Personal.—Mr. J. N. Stephens, manager of the wiring supplies department of the British Thomson-Houston Co., Ltd., has left on a two to three months' trip to the United States to study the latest practice in electric lighting.

---

* See *Proceedings of the American Academy of Arts and Sciences*, 1912, vol. 48, p. 113.

* *Proceedings of the American Academy of Arts and Sciences*, 1915, vol. 51, p. 421.


Don't worry!
THERE IS A
BENJAMIN
REFLECTOR
for
EVERY CLASS of
LIGHTING
INSTALLATION.

Advert. of the Benjamin Electric Ltd., Brantwood Works, Tariff Road, N.7.

TO OUR READERS.

ELECTRICITY is published every Friday and, is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and Abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Tuesday morning, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription : 13s. a year, 6s. 6d. half year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

E.D.A. at Wembley.

I suppose all electrical engineers in Great Britain, as well as thousands of those from overseas, are looking forward with keen interest to the wonders which will be on view when the British Empire Exhibition opens its doors in April next, and I do most sincerely hope that every endeavour is being made to support the Electrical Development Association in putting up a show which will be worthy of our profession and give the industry an impetus which will carry it along in prosperity for many years to come. The expenses of any contributions which may be made by any sections of the community, whether company, corporation or society, want to be looked at from the broad standpoint of collective as against individual or sectional benefit. I have an idea that many such possible contributors are delaying their decisions longer than is really wise under the circumstances, and I therefore put in my humble appeal for generous support from all sections and no haggling about actual direct return on any grant which may be made. We want to make a really magnificent show, and for that reason the E.D.A. enterprise wants full support—more support—universal support—and we must see that it gets it.

Overdoing it?

Signs are not wanting (no pun intended) that the large numbers of jazz and syncopating signs in the West End of London are causing the responsible authorities some anxiety. According to report, discussions are proceeding between the Streets Committee of the London County Council and the Westminster City Council on the subject of the control of the many electric night signs and advertising devices now to be seen in Piccadilly and neighbourhood. It seems that objections have been raised in certain quarters on the ground that the signs tend to interfere with traffic arrangements, and that possibly the attraction of the signs makes conditions unsafe for ordinary pedestrians by reason of the crowds which congregate to watch them. Whilst these brilliant and highly ingenious advertising devices undoubtedly tend to brighten London, there is perhaps something to be said in support of the objections now being raised.

Whenever a new idea, such as the modern scintillating sign, is introduced and happens to attract popular attention, there is invariably a tendency to overdo things, and thus, in the end, bring disaster upon what is really an excellent advertising medium provided it is utilised with due regard to public safety, interest and without unduly detracting from the architectural surroundings of a particular district. The trouble with London's electric signs, to my mind, is that they are unduly concentrated in one spot, thus causing considerable traffic congestion; that they do not always constitute a good advertisement, inasmuch as the subject-matter advertised is often lost sight of in the extreme novelty of the sign itself; and, thirdly, that they are in one or two instances unduly dazzling in their effects, and on this head more suited to the illumination effects of an exhibition grounds or a public park, where there is plenty of space to observe them in comfort and to move about whilst so doing.

Probably the signs which at present give most trouble to the traffic police are not so much the set pieces and scintillating signs as those which spell out the principal items of news in illuminated type. Of necessity the pedestrian has to stand and gaze for a considerable period to follow some of the paragraphs thus displayed upon prominent buildings in the vicinity of thoroughfares already so seriously congested with ordinary traffic, and it needs but little reflection to realise that this loitering in order to read what is on the signs must give the traffic police quite an appreciable amount of extra work, keeping things on the move and avoiding casualties. The electric sign is too good a proposition to suffer early suppression through no fault of its own, but rather an error of judgment on the part of its promoters, and I sincerely hope that those who are at the back of the electric sign movement will take the hint now so publicly given and endeavour as far as possible to temper their enterprise with sound judgment regarding the design and disposition of these aids to publicity.

The Overcrowded Ether.

Already the enormous growth of wireless telegraphy and telephony is causing difficulties in connection with the selectivity of messages, and the so-called "jamming" difficulty is a very real one, which at times may conceivably lead to loss of life through the inability of a ship in distress to make itself heard above the mass of other signals passing through space at the time the S O S is transmitted. We have received an interesting communication on this subject from M. Yves Marrec, a well-known French wireless engineer, who comments on the serious difficulty already experienced among coastal wireless stations in communicating with each other, particularly in congested areas where several near stations are transmitting simultaneously on the same wave-length.

As M. Marrec points out, it is the duty of the first station which picks up a distress signal to immediately stop transmitting and get into touch with the sender of the distress signal in order to render help with the utmost dispatch. If the receiving station is jammed whilst trying to establish communication, it should call upon all the other stations causing the jamming to cease transmitting and thus leave the ether free for the time being until the S O S call has been satisfactorily dealt with. In theory this procedure is perfectly correct, but the trouble is that with so many stations sending and receiving, each pair intent upon its own messages, often in themselves difficult to pick up due to the jamming, the unfortunate S O S call is not heard, and the confusion continues until it is perhaps too late to render aid.

M. Marrec instances an actual happening of this description during the great gale of last August, when several men were drowned from the wrecked French collier off the English coast. He heard the S O S call sent out repeatedly by this ill-fated vessel to the North Foreland, which station repeatedly called for silence to enable it to locate the vessel in distress, but without response, due to the very considerable jamming going on at the time. On top of this tragic circumstance M. Marrec also heard the music broadcast from 2LO, but in the circumstances was unable to render any assistance. To overcome this difficulty and still preserve the invaluable services of wireless as a life-saving medium, he advocates a characteristic and distinctive note to be reserved exclusively for wireless distress signals, and which would attract the special and certain attention of all transmitting operators within range, much after the manner in which a characteristic fire bell at once conveys its warning to the most disinterested and otherwise preoccupied person.

According to M. Marrec, it would be quite a simple matter to modify existing stations in order to achieve this object. There are quite a number of methods, either by damped waves or modulated continuous waves. He further adds that there exists to-day apparatus which will only respond to the action of currents having a specific frequency—that is to say, on one note—and will not operate on any other, however powerful. He advocates the use of such apparatus arranged to ring an alarm bell or operate any other audible or visual alarm signal immediately an S O S call reached its sphere of influence. Such a combination, if practicable, would certainly appear highly desirable in the interests of saving life at sea, in addition to obviating the necessity for continuous and lengthy spells of listening-in by sea-going operators who are otherwise off duty.

The Disappearing Arc.

In view of the considerable displacement of the once-popular arc lamp by the high candle-power gasfilled unit, some interest attaches to the fact that Detroit, U.S.A., claims to possess the largest arc lamp installation in the world. The street lighting of Detroit is by means of arc lamps, of which there are no less than 14,677 in use at the present time. From the year 1883, when the first arc lamps were fitted for street lighting in Detroit, no more economical and generally satisfactory system has been found. Great improvements have been effected in arc lamps since those early days. The first installation consisted of open arcs, to be followed later by the enclosed carbon lamps, but really satisfactory results were not secured until the advent of the magnetite or luminous arc lamp. The first of these lamps was installed in Detroit in 1909. To-day there are 14,677 magnetite arcs, constituting the whole of the local street lighting.

ELEKTRON.

V.I.R. CABLES—THEIR MANUFACTURE AND SELECTION.*

(Continued from page 13.)

Certain other requirements, such as flexibility and the elasticity and resilience of the insulating coverings are necessities, without which it would be an impossibility to comply with the foregoing three prime conditions.

The greatest stress is rightly laid on the value of the insulation, and it is customary for the manufacturer to issue a certificate, in the form of a label sealed to each coil, on which the insulation resistance of the wire is certified.

This certificate has led to a rather unfortunate idea that this guarantee by itself is a sufficient evidence of the soundness of the cable, quite overlooking the fact that there is nothing to indicate on the guarantee as to whether this initial insulation resistance will be maintained for any reasonable length of time. Herein lies one explanation of what has been a stumbling-block to many users of cable—namely, the difference between a C.M.A. 600 meg. grade cable and a N.A. 600 meg. class cable—both, you will note, having the same insulation resistance.

There is no test of any kind which can guarantee a definite life to any cable, except that of the test of time itself; but established practice, practical experience and careful investigation of faults, which are the outcome of age in working the cable, have enabled the manufacturer to provide against a weakness which has developed in that time.

I have referred previously to the influence of time, of heating, and of the amount of sulphur, and in addition to add to these varying factors we must remember what I previously referred to under "Vulcanisation," that rubber is manufactured into goods having two widely divergent uses:—(*a*) V.I.R. goods requiring mechanical properties, such as strength, as their principal asset; (*b*) V.I.R. goods with properties to meet electrical conditions.

The divergence between these factors was very ably dealt with by C. T. Beaver in his paper to the Institution of Electrical Engineers in 1914, in which he showed that efforts to co-ordinate them (i.e., physical properties) with electrical properties have not been, and cannot be, successful in the present state of the art.

Fortunately, this relationship is not an essential feature, the true qualities required being essentially electrical, while the mechanical properties required are that the V.I.R. will have such measure of firmness and of elasticity as to enable it to retain its electrical efficiency however handled or installed.

---

* Lecture delivered by William Lang, M.I.E.E., before the National Assoc. of Supervising Electricians, November 13, 1923.

Hence the manufacturer, in dealing with this problem, must endeavour to secure the all-important insulating properties, together with such factors as flexibility, elasticity, resilience, and reasonable long life.

It is easy to sacrifice any one of these factors at the expense of the others in the process of vulcanisation, even when every care has been taken in selecting the ingredients forming the compound to be vulcanised.

In order to satisfy himself, the contractor might submit the cables he uses to periodical tests by an independent body, as, for instance, the National Physical Laboratories, who have the plant and the personnel to investigate such tests as stretching, test heat of di-electric and pressure tests, especially as the average contractor has insufficient leisure for this purpose. One test which was commonly called for at one time is now dispensed with, this was known as "the percentage of ash test" obtained after having the V.I.R. coatings. It has little real value owing to the volatisation of the inferior ingredients which the test attempts to show in the amount of ash.

Mr. F. T. Alldread, opening the discussion, expressed the interest the paper had manifested, and complimented Mr. Lang. He generally detested rubber cables, and was not sure the general trend was on the right track, and instanced cases where in difficult places he had found vulcanised rubber cables did not hold. He had found that any rubber cable would hold in water or where dry, but he had not come across a rubber cable which answered for an interim state of conditions.

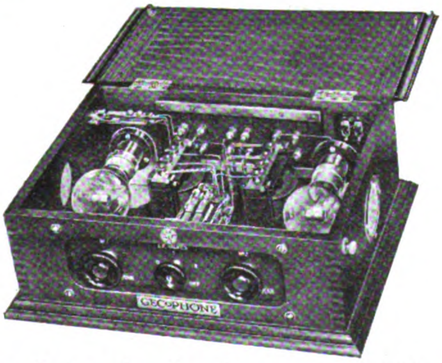
Mr. Joyce also complimented the lecturer, and said the statements he had made were common-sense ones, and that the test of cable which had been put forward was about the most sensible one he had heard.

Mr. P. N. Hindell asked for information regarding ozone-proof cable which would stand up against H.T. Generally speaking, he congratulated the cable makers on the small number of breakdowns which had taken place.

(To be continued.)

A NEW "GECoPHONE" AMPLIFIER.

We give herewith an illustration showing a new "Gecophone" two-stage power amplifier, which has now been placed on the market by the General Electric Co., Ltd.



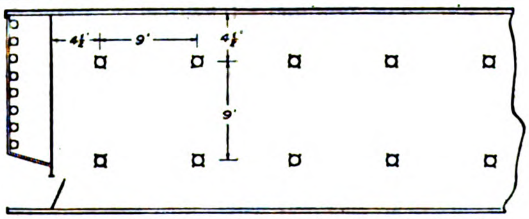
It was designed primarily as an addition to the "Gecophone" two-valve set, and is suitable for use with any broadcasting receiver. It is the result of careful research and study of broadcasting requirements, with the result that, with a good loud-speaker and moderate skill in tuning, everyone now may obtain sounds pure and free from all distortion. The instrument is completely enclosed in a polished mahogany cabinet, with a flat top lid acting as a base for the receiving set, and is among the most handsome, as well as the most efficient it has been our pleasure to review.

All connections are made by plugs and sockets to an ebonite panel at the back of the amplifier, rendering connections extremely simple, and avoiding the eye-sore of unsightly leads. Full control of the valves is obtainable, and all batteries, including those of receiving sets, can be switched off completely if desired, whilst a further switch enables headphones to be used together with, or independently of, the loud-speaker.

LIGHTING DESIGNS FOR SHOPS AND STORES.

Lighting Service Handbook No. 2, which has just been issued by the Lighting Service Dept. of the British Thomson-Houston Co., at 15, Savoy Street, London, W.C.2, is entitled "Lighting Designs for Shops and Stores," and covers this particular branch of electrical illumination in a very comprehensive manner. It should, therefore, be of immense assistance to all installation contractors, and any who have

Design 5a. Shop 18 ft. wide Ceiling Height 10-12 ft.



Mounting Height of Enclosing Units—Not less than 9 ft. above floor.
Suspension Distance to Top of Bowl Units—1½ to 2 ft.

Approximate Average Foot-Candles Using 150-watt* Gasfilled Lamps

Type of Fitting	Light Ceiling		Medium Ceiling	Dark Ceiling
	Light Walls	Medium Walls	Medium Walls	Dark Walls
Enclosing—Light Diffusing ...	7	6	5½	4
Enclosing—Light Directing, or Semi-Enclosing	8	7	6½	6
Semi-Indirect or Totally Indirect	6	5½	4½	—

Display Windows—Points as shown represent usual practice for average display window. See pages 36 to 40.

* To obtain approximately the same foot-candle values with **Daylight lamps, use** 200-watt size.

18

not received a copy should write and ask for it without delay. It is beautifully printed, thus enabling readers to obtain a really good idea of the effects which can be produced by following out the various designs, and the company can be most cordially congratulated on their enterprise in assisting installation engineers to develop the science of illumination in an efficient manner. As a matter of fact, the information in these handbooks is so useful that they will be referred to constantly by those who receive them and appreciate the advice they give. The plans and diagrams are wonderfully clear and explanatory, so there should be no difficulty in grasping essentials in each scheme.

Our illustration shows one page of this handbook indicating the interior of a shop and the design of the lighting system used. From this illustration it will be seen that a design, stripped of all technicalities, is presented in a simple and practical manner. If the simple details as regards spacing, mounting heights and type of units are followed, the desired intensity of light is obtained upon the goods displayed.

CROMPTON-ROBERTSON BRIDGE POTENTIOMETER.

In the summer of 1922 we reviewed a book entitled "Experiments with the Slide-Wire Bridge,"* edited by Prof. David Robertson, of the Merchant Venturers' Technical College, Bristol, and the many readers of that work will, we are certain, be extremely interested in the new leaflet No. 760E, illustrating the Crompton-Robertson Bridge Potentiometer, which has just been placed on the market by Crompton and Co., Ltd., of Chelmsford. It has been specially adapted by them for use in meter test rooms, so it should appeal to all central station engineers, and Messrs. Crompton invite applications for copies of the list. The instrument will meet the double purpose of an ordinary double-gap slide-wire bridge, and a simple form of potentiometer for ampere, volt and resistance measurements and for millivolt tests. The complete set for the above tests consists of :—

One four-gap slide-wire bridge potentiometer.

One three-terminal resistance box of 1-10 ohms, to carry one ampere, with dial pattern switch.

Two standard coils, one of 1 ohm and one of 91 ohms, of open pattern and high current carrying capacity, made to screw directly into the gaps of the bridge.

One 10 ampere resistance, 0.1 ohm at a drop of 1 volt, with an accuracy of one in 1,000; also designed to carry 100 amperes at 1 volt, to enable it to be utilised when using the set as an ordinary potentiometer.

One-volt box for maximum range of 600 volts, with tappings at 100, 200, 300, 400, and 500 volts.

One standard cadmium cell.

One adjustable rheostat.

The list gives illustrations thereof and also a set of diagrams showing the connections and arrangements necessary in carrying out :—

Measurement of voltage and voltmeter calibration.

Measurement of current and ammeter calibration.

Measurement of low voltages.

Measurement of low resistance.

Together with the explanatory text, giving all the necessary instructions.

Questions and Answers by Practical Men.

RULES.

QUESTIONS : *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid or the question which we select for competitive replies in this column.*

ANSWERS : *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

Commencing with Question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 175.

When working a cinema projector on 200 volts A.C., 50-cycles, using about 15 amperes, with 3-bladed shutter on machine, an intermittent light was produced on the screen. The carbons were burning steadily and not spluttering. By using a single-bladed shutter a good picture was obtained. Can any reader explain this?—"OPERATOR."

QUESTION NO. 176.

I have a foot-candle meter and the battery is run down, and, I am told, the meter will require recalibrating. Is this so, and, if it is so, how can I calibrate it?—"ILLUMINATOR."

(*Replies to Questions Nos. 175 and 176 must be received not later than February 2, 1924.*)

[QUESTION NO. 169.—The additional second prize-winner's answer is unavoidably held over until next issue.]

Reviews of Books, &c.

[***Books noticed in this column will be sent from* ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.***]

WHITAKER'S ALMANAC, 1924 (Whitaker, 3s. and 6s.).—Our old and valued friend has made his annual bow, and has likewise received his usual cordial welcome as an office companion to whom reference is constantly made and who just as constantly furnishes us with the information which we may require. We expect that our experience is repeated yearly in thousands of other offices and homes, and can therefore only say that, if it has not yet been purchased, no time should be lost in doing so.

TECHNICAL ELECTRICITY (4th edition). By H. T. Davidge and R. W. Hutchinson. 514 pp., 403 figs. (University Tutorial Press, 10s. 6d.)—We have much pleasure in bringing to the notice of our readers the fourth edition of this well-known book, which is, in our opinion, one of the best text-books issued. Whilst the special aims and general arrangement of the subject-matter remain as in the earlier editions, the book has now been entirely reset, and the use of a rather larger page is a distinct advantage, enabling as it does many improvements to be made in the diagrams and general production. Much new matter has been incorporated, particularly in connection with the following subjects:—Electrostatic and magnetic theory; lines of force and induction; the magnetic properties of iron; international and legal units; instruments and testing; lamps and illumination; magnetic theory and circuits; generators, motors, boosters and other machinery; telegraphy and telephony (wire and wireless). It will be seen that even those who possess the earlier editions cannot afford to dispense with this new volume, whilst any student who has not already seen the work should take the earliest opportunity of referring to it; he will undoubtedly be as firmly convinced as we are concerning the excellence and utility of the treaties. No previous knowledge of the subject is assumed. A thorough explanation based on sound scientific principles is given in every instance, the book is profusely illustrated by line drawings and diagrams, and there are hundreds of worked examples and set problems, with answers. Whether for private study or class tuition, the book is to be most highly recommended.

---

* 3s. 3d., post free, from S. Rentell and Co., Ltd.

MODERN RADIO COMMUNICATION. By J. H. Reyner, B.Sc. (Pitman, 5s. net).—The scope of this book is to cover the new City and Guilds examination on the subject of radio communication, and it should also be useful to those about to sit for the P.M.G. certificate, or those operators who wish to sit for the overseas examination. It may, indeed, be distinguished from most books on radio by the fact that it deals with commercial wireless, and is written with this object entirely. As a serious text-book on the subject it is strongly recommended. It may rightly be called non-mathematical, and it fills an otherwise vacant place in wireless literature. There are surprisingly few text-books suitable for serious students who wish to master the fundamental principles of the production, transmission and detection of electro-magnetic waves. The historical side is now entirely obsolete or of little importance, and such matter is unfortunately too often repeated in books on this and like subjects. In Mr. Reyner's book the historical side is entirely omitted and the work gains in consequence. Considerable trouble has been taken to give a clear idea of fundamental principles, and these principles are without question amply and clearly described in an able and simple way. The page relating to "Conception of Back E.M.F." is worthy of mention, and expresses the matter from the new viewpoint of special interest. In giving the dielectric strengths of various materials, it is stated that the values are for plates 1 mm. *apart;* this obviously means for plates 1 mm. thick. The dielectric strength of ebonite is given as 30,000 volts. The latest specifications of any consequence call for a value of 80,000, so that the figure given is about right for average commercial qualities, but hardly high enough for serious radio work. In referring to the "Mansbridge" condenser, the term "tea-paper" is employed, but it is not made clear that ordinary tea-paper or tin-coated paper is not referred to, as paper of this kind is not a conductor, or at least cannot be relied upon as such. The "Mansbridge" coated paper is specially manufactured to render its coated surface conductive. The pages on inductances make clear some points obscure to many, and the text relating to resonance is particularly explicit and lucid. As a text-book it is very practical, and the consideration of electro-magnetic waves confirms this, and points out theoretical fallacies to be avoided. Without dealing in any detail with other matters, it is sufficient to say that all commercial wireless matters of any real use are included. The book is well written, amply illustrated and diagrammed, and after reading it one wishes the author would give us, at some later date, an enlarged and more detailed work on the same subject.

A FIRST COURSE IN MACHINE CONSTRUCTION AND DRAWING. By T. M. Naylor, B.Sc., A.M.I.C.C., A.M.I.E.E., and W. Tattersall, Assoc. M.C.T., A.M.I.C.C. (Witherby, 6s. net.)—An experienced man would look at this book and say that there was no information in it of particular use to him, and he would be right, but for the man who is starting either as a junior draughtsman or as a student at an engineering school, it is just the thing to meet his needs. Unfortunately, masters at schools forget occasionally that their students are often absolutely ignorant of quite simple terms, or, if they know the term, they are not quite sure what the thing looks like. With this point in view the authors have assumed absolute ignorance on the part of the reader, and gradually acquaint him with the many different objects which are taken for granted by the experienced man. A blank page is left after each section, where additional notes can be inserted, and if the book is taken care of and all notes inserted neatly and clearly the young engineer will have a text book which will probably prove invaluable to him in after years. Every definition is accompanied by a simple sketch, generally giving chief dimensions, but it would have been better if a few more proportions had been given, rather than measurements which only apply to the design shown. Proportions are very useful, for with them a man can design for all sizes, still retaining the same general form. This greatly assists standardisation. The tables given at the end are excellent, but are somewhat limited. Additions can, however, be easily inserted. The descriptions throughout are excellent, combining briefness with clearness, and altogether the book is one which any young engineer would do well to obtain.

Automatic Control.—A new universal regulator for the control of temperature, pressure, humidity, etc., was the subject of a paper read by Mr. Thomas Lindsay at a meeting of the Inst. of Heating and Ventilating Engineers on January 9, 1924, when he described the Arca automatic regulator and its application to the automatic control of high or low pressures in steam or liquids, pressure or vacuum in gases, the regulation of the production of gas in gas-producer plants, the control of temperatures in gas-works condensers, calorifiers and drying tunnels, the control of humidity and temperature in air-conditioning plants, de-superheating of steam, the control of load on electric motors, pressure of steam on back-pressure or pass-out engines, and levels in tanks or other vessels either under pressure or vacuum. Recently great strides had been made in automatic regulation by the use of this regulator, and many problems previously considered impossible could now be successfully accomplished. Judging by examples given in the paper, it was evident that the applications were unlimited.

Various Items.

Meetings.—The I.E.E. will meet in the Lecture Theatre of the Inst. on Thursday, 17th inst., at 6 p.m. Paper: "Electric Passenger Lifts," by H. Marryat, Member.

Finance.—An interim dividend of 7 per cent. per annum is to be paid on the preference shares of Crompton and Co., Ltd., for the six months ended September 30, 1923.

International Language.—On January 15 will appear the first number of the new monthly, *International Language* (twopence), which will deal in a popular manner with various aspects of the international language problem, language study and teaching, travel, and similar related topics.

Blackpool.—Mr. A. D. Murdoch, who has been appointed manager of Melbourne and Metropolitan Tramways Trust—a large consolidation of tramway interests in the city—was trained at Blackpool, where, after serving his time with Messrs. Challinor, he became assistant to Mr. C. Furness, in the Corporation Electricity Department. He went to Australia 18 years ago.

B.E.X. Posters.—We have received from E.D.A. a set of seven different coloured posters illustrating typical views of what the great show at Wembley will be like when in full swing. An advance display of this nature is certain to excite interest in the exhibition, and will help to attract visitors from outlying districts of Great Britain as well as from all parts of the globe.

Personal.—Mr F. W. Bridges, organiser of the Shipping, Engineering and Machinery Exhibition, has left this country for a three months' visit to South Africa, where he hopes to have the opportunity of meeting many of the principal engineers in that part of the world with the object of increasing the usefulness and success of the next Exhibition to be held at Olympia in 1925.

Plant Wanted.—The Municipal Council of Johannesburg invite tenders for the supply and erection of a turbo generator plant and accessories.—The Commercial Secretary at Copenhagen has been approached by a Danish firm of bespoke tailors who are desirous of getting into touch with British manufacturers of electrical machines for pressing the seams of trousers. —The Municipality of Mafeking invite tenders for the supply and installation of an electric generating plant (Contract No. 2). Specification and conditions available at the D.O.T. (Room 52), 35, Old Queen Street, Westminster, S.W.1.

Calendars, Diaries, etc.—We have received the following kindly reminders of the New Year:—From Crompton and Co., Ltd., a monthly calendar, each sheet of which bears an illustration of some special plant installed by them in various parts of the world.—From Haslam and Stretton, of Cardiff, a monthly calendar bearing a charming illustration in colour of "Joan," who looks as if she must be a very captivating young lady in real life.—A useful vest pocket diary from the Edison Swan Co., Ltd., the front pages of which contain much information about the various manufactures of this veteran undertaking, which under its present management seems to have taken a new and prosperous lease of life.

Social.—The annual dinner of the indoor and outdoor staffs of Francis Polden and Co., Ltd., electrical engineers, of 56, Cannon Street, London, took place on the 5th inst. at Slater's Restaurant, 50, Cannon Street, when the Chairman of the company, who presided, was presented by the staff with a case containing a chairman's hammer and striking block in recognition of the great esteem in which he is held, the presentation being made by the Secretary. The important toast of the evening, "The Chairman and His Company," was proposed by Mr. R. T. Shaw, one of the oldest members, and when Mr. Polden rose to reply he was received with great applause, after which he expressed the great satisfaction it gave him to preside at the function. Mr. P. Wood welcomed the ladies and visitors, to which an amusing response was given by Mr. W. T. Smith. Mr. Polden proposed the toast of "The Indoor and Outdoor Staffs" in very flattering terms, and Mr. W. T. Buswell, in replying for the indoor staff, said that it was a pleasure to work for Mr. Polden, while Mr. H. G. Simmonds, responding for the outdoor staff, said that as they worked for a tip-top company they should give of their best in return and take as keen an interest in their craft as possible. Mr. A. C. Hill, on behalf of the company, congratulated the Social Committee on the great success of the evening, and Mr. E. D. Gill responded. An excellent musical programme was given by "The Gay Sextette" Concert Party, and a most successful evening was brought to a close with the singing of "Auld Lang Syne."

Smoking Concert.—The next Electro-Harmonic smoking concert will be held in the Caxton Hall, Westminster, to-night, Friday, 11th inst., at 8 p.m. Chairman: Percy Rosling, Esq.

Reminder.—The annual dinner of the Electrical Contractors' Association will be held at the Hotel Cecil on Tuesday, January 15, at 6.30 p.m. for 7 p.m., and the Secretary of the Association hopes that members will not forget this very important date.

Congratulations.—We congratulate Mr. Walter M. Citrine, who has been for quite a number of years assistant secretary in the head office in Manchester of the Electrical Trades Union, on the fact that he has been appointed assistant secretary of the Trades Union Congress at a commencing salary of £450, rising to £500, out of five hundred candidates.

Meetings.—The Inst. of Production Engineers will meet at 7.30 p.m. on Wednesday, 16th inst., at the Engineers' Club, Coventry Street, London, W.1, when Messrs. J. E. Baty and A. J. C. Brookes, of the Pitter Gauge and Precision Tool Co., Ltd., Woolwich, will deliver a paper dealing with "Accuracy in Production Engineering," to be illustrated by lantern slides. All interested are invited to attend, whether members of the institution or not, and no tickets are necessary.

Tenders Accepted.—The L.M. and S. Ry. Co. (Midland Division) have accepted the tender of the Siemens and English Electric Lamp Co., Ltd., for the supply of gasfilled type lamps for six months from January 1.——The G.E.C. have recently booked orders from the R.M.S.P. Co.—part contract for the supply of metal and carbon filament lamps; the Booth Steamship Co., Liverpool—supply of Osram lamps; and the G.N.R. —supply of traction lamps, gasfilled lamps and special lamps; in each case for the year 1924.——The owners of the Aberdeen Line steamers have accepted the tender of the Siemens Lamp Co. for the supply of lamps for the six months ending June 30.

Australia.—According to the current issue of the *B.O.T. Journal*, Australia offers an increasing market for electrical machinery, which would appear in certain cases to justify British manufacturers in strengthening their Australian organisation. It is to be hoped that these remarks will bear fruit, as there is always a certain inclination in favour of British plant, as compared with foreign made plant, in the Australian Commonwealth, and this should, of course, be made use of to the utmost possible extent in order to increase our export trade.

Trade Notes.

Messrs. G. D. Atkin and Co., stockbrokers, of 1, Drapers' Gardens, E.C.2, who are well known throughout the electrical profession as specialists in the share market dealing in electric light, power and traction undertakings, have just recently rendered yet further service to their numerous clients. "Atkin's Manual," which gives facts and statistics about all the important companies referred to above, is now being supplemented by the issue, as opportunity permits, of well-printed maps of the districts covered by the various London undertakings. The four which have so far been issued are:—(1) Map, 40 x 30, of the areas served by the Electric Lighting and Power Companies of London; (2) the Metropolitan E.S. Co., Ltd.; (3) the County of London E.S. Co., Ltd., and (4) the North Metropolitan E.S Co., Ltd. They will most certainly interest all investors as well as every central station engineer.

Sample Pair Sent on Approval for 8/6

Made of Pure Para Rubber soft and durable and unaffected by climatic conditions.
DAVID MOSELEY & SONS
Limited.
ARDWICK. MANCHESTER.

MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

JANUARY 18, 1924.

CONTENTS. PAGE

Training the Boy 27
Armature and Coil Winding from a Conversion Point of View 28
The Osram Lamp Works Dinner 29
V.I.R. Cables : Their Manufacture and Selection 29
Troubles Experienced with Domestic Appliances 30
An Interesting Demonstration 30
Current Topics 33
A New Multiple-Retort Unit 34
Questions and Answers by Practical Men 35
Problems in Telephony, Solved and Unsolved 36
Debenhams and the "Relay" P.A.B.X. 37
Reviews of Books 37
Various Items 38

TRAINING THE BOY.

By W. J. Hiscox.

In these days of specialisation, apprenticeship (as once understood) is at a discount, the tendency being to get boys into the factory and train them to become proficient in one certain direction. In favour of this it is asserted that there is no use for the "all-round" man, and that, as a consequence, there is no need for the boy to undergo a thorough all-round training.

This appears to be a very selfish policy—unfair to the boy, and (what may weigh more with the management) unfair to the industry. The boy, naturally enough, is elated with the relatively high wages he receives when he becomes proficient, and is not disposed to risk a monetary loss in striving after greater knowledge. He does not realise that what may be considered high wages for a boy are low wages for a man, and that, unless he can rise above his present job, he will be a poorly paid workman when he reaches adult age.

There may be no need to-day for a protracted apprenticeship course, but at least the training a boy receives should be sufficient to develop him into a proficient craftsman. We are in danger of producing too many "semi-skilled" men, and that is a term which should never be applied to an engineering workman.

In very many factories the management fails to discharge its obvious duty to the young people employed therein; and the more proficient the boy, the more is the tendency to keep him on the job in connection with which he is proficient. Thus the easiest line of resistance is followed, and for the moment all parties are satisfied. Of the future, no one cares. "Sufficient unto the day" is everybody's motto. Cheap production for the management, good wages for the boy—a triumph for specialisation.

When the boy becomes a man he is a "semi-skilled" mechanic, commanding a relatively low rate by reason of the narrowness of his experience. He is an expert—at a boy's job; and if he cavils at his wages, he can be replaced by a boy at a still lower rate. Thus the individual suffers for his youthful short-sightedness and cupidity. And what about the industry?

Is it not obvious that the more specialisation in the matter of production develops, the greater will be the call upon management? And how will it respond if the training of the younger generation has brought into being a body of automata, with no vision beyond the specialised job they have too thoroughly mastered. It may be contended that management itself is a specialised job, but its scope is broad, and many specialised phases are included. It follows, therefore, that he who would manage must possess not only the characteristics, but the knowledge of a manager. The super specialist of narrow aspirations cannot hope for success, for nineteen-twentieths of the factors of management are a sealed book to him.

Leadership in the abstract may result from intensive specialisation; but whither will it lead if comprehensive knowledge is not attained? In a department there may be twenty specialist mechanics, each an expert at his own particular job; but for the maximum efficiency to be attained those twenty specialists must be controlled by a foreman, who, apart from leadership qualifications in the abstract, must have some knowledge of each of the twenty jobs that are under his control. In the factory there may be ten department heads, each a competent man in respect to the duties he has to perform; but, unless the higher control is vested in a man who has some knowledge of the duties peculiar to each of the ten departments, real efficiency is out of the question.

Under the present scheme of things, from where shall we get our foremen and works managers? We have them to-day, but what of to-morrow? Surely specialisation is a mistake when the case is viewed from this aspect, and yet it is favoured more and more every day.

Whilst to-day we have experienced managers, it may be that specialisation methods are justified by results; for obviously the more narrow the range of activity, the greater the concentration, and as a consequence efficiency is more pronounced. This, however, is due to the fact that the specialised methods are engineered by men of broad experience, who can appreciate the significance of any circumstance; but, when the day of these experienced men is past, to whom shall we look as their successors? The answer is: The specialists they have created—the one-idea men, who see nothing to the right or to the left of their own particular job, because their range of vision is obscured by blinkers.

We have got to get back to the apprenticeship system—or, rather, a modernised version of it. The training of our boys must be even more thorough than before, because we see in each one a potential manager, and he must have his opportunity. And that is where *real* specialisation shines. After a probationary period the inclinations and the natural resources of the boy are apparent, and then is the time to specialise. It must, however, be a gradual process, its development following the bent of the individual. At the outset of a boy's career his notions are clouded by lack of knowledge He feels that he wants to be an "engineer," and it is with this end in view that he enters the factory. After a few months on general duties he gets a truer perspective of his inclinations, and there is something tangible to go upon. A definite branch is decided upon, which may be design, mechanism or administration, and this is followed in a somewhat broad sense until right knowledge suggests further specialisation.

It is in this way that the real specialist is evolved—the specialist with leadership qualifications; for, no matter what specific branch is favoured in this first instance, the job at the top is worth striving after. The chief draughtsman, who may be head of an important designing department, or the chief tool designer, who may control the entire tool organisation, evolve from the boy whose natural aptitude is toward designing, and who is given the opportunity of developing his natural resources. For the boy with a mechanical turn of mind there are the positions of works engineer, foreman, lathe-setter, and the like; whilst the positions of works manager, production manager, progress manager, storekeeper, etc., are for the boy whose leanings are towards administrative duties. From this it will be seen that a thorough training is still necessary, even to produce specialists, and undoubtedly the future of industry depends upon the attention given to the training of the younger generation.

ARMATURE AND COIL WINDING FROM A CONVERSION POINT OF VIEW.

By C. Sylvester, A.M.I.E.E., A.M.I.Mech.E.*

Amperes × turns are the component parts of the term ampere-turns, a term usually employed in the winding of armature coils, field coils or solenoids. It conveys the impression that, given a certain amount of current passing through a definite number of turns, after factors such as the radius of coil and its length are considered, a definite flux density is produced. If this flux density is to remain constant, then the ampere-turns must remain constant, although both the amperes and turns may vary in quantity.

The product of 10 amperes and 1,000 turns is equal to 10,000 ampere-turns, just as 20 amperes and 500 turns are equal to 10,000 ampere-turns. Although the result in both cases is the same, this result is brought about by the variation of several factors. A consideration of these factors will pave the way for an easy understanding of the more intricate factors which have to be considered when dealing with the winding of armatures.

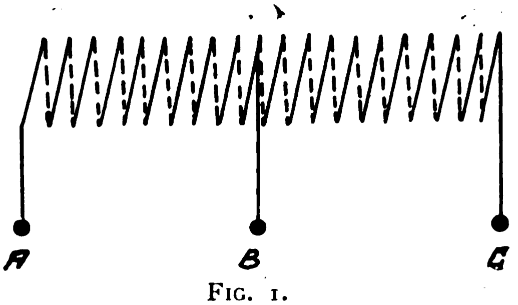


Fig. 1.

Fig. 1 illustrates a coil consisting of a certain number of turns with a tapping at the centre so that one half of the coil, or the whole of it, may be placed across a constant voltage. If terminals *A* and *B* are connected to the supply, a certain amount of current will flow round the turns of the coil, thus producing a definite flux from a number of ampere-turns. If, however, terminals *A* and *C* are connected to the supply, the number of turns will be doubled, but the resultant ampere-turns will remain the same as in the first case. This is because the amount of current has been halved, due to twice the resistance of the coil. This may be shown as follows:—

Let the resistance of the complete coil be 20 ohms, then the resistance between *A* and *B* will be $20 \div 2 = 10$ ohms. Now if the supply voltage is 20 volts and *A* and *B* is connected across it, then the amount of current will be:—

$$I = \frac{E}{R} = \frac{20}{10} = 2 \text{ amperes.}$$

That is, where I is the current, E the voltage and R the resistance of the circuit under consideration. When *A* and *C* are connected across the supply the current will be:—

$$I = \frac{E}{R} = \frac{20}{20} = 1 \text{ ampere.}$$

From this it will be seen that to increase the number of ampere-turns of a coil or solenoid, other factors have to be considered in addition to the number of turns and the amount of current through the coil, that is, if the voltage is to remain constant. In the case already given, of course, if the voltage had been increased, then the amount of current would have also increased. Therefore, since the turns are constant, then the number of ampere-turns would have been increased. Similarly, if the voltage is to remain constant and the turns are to be constant, then the resistance of the solenoid must be decreased if the current through the coil is to be increased. In other words, the coil must be wound with the same number of turns with wire of a larger cross-sectional area.

It is often necessary to increase the number of ampere-turns of small coils, such as no-load coils for motor starters. The necessity for this is that, at times, it is found that, although they hold on quite efficiently when under test, when they are in position in a machine shop they become inefficient through vibration. In this case the number of ampere-turns may be increased by merely placing more turns on the coil of even smaller wire, that is, if space and the smaller cross-sectional area of the wire, from a current-carrying capacity point of view, will allow it. This is shown in Fig. 2.

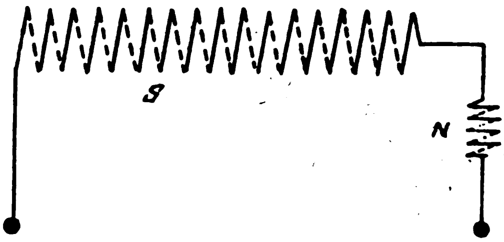


Fig. 2.

Here *S* is the shunt field of a motor, which we will assume has a resistance of 400 ohms. It is connected in series with *N*, the no-load coil having a resistance of 5 ohms. If this circuit is connected across a 400-volt supply, the amount of current through the no-load coil will be .987 amperes. Now, taking an extreme case and assuming we desire, approximately, double the number of ampere-turns on *N*, if we place twice the number of turns on it, then its resistance will be increased to 10 ohms. If the circuit is now placed across the supply pressure of 400 volts the amount of current through *N* will be .975 amperes, exactly .012 amperes less than before, yet we have doubled the number of ampere-turns approximately.

---

* "Armature Winding," by Mr. C. Sylvester, is a clearly written practical work for the armature winder. It may be had for 8s., post free, from Electricity Office.

The above considerations, although elementary, are very important and must be thoroughly understood before winding conversions can be successfully carried out. In electrical work it is the small things that count, since it is often the case that large things cannot be attempted because the small things have been forgotten.

(To be continued.)

THE OSRAM LAMP WORKS DINNER.

As usual Mr. Chris Wilson presided at the annual staff dinner of the Osram-G.E.C. Lamp Works, which was held at the Café Royal on Saturday, January 12. He was supported by Mr. Hirst (chairman) and other directors of the General Electric Co., the guest of honour on this occasion being Sir Arthur Steel Maitland, Bart., whose name has long been most intimately associated with the development of empire trade. The steady growth of the Brook Green factory was evidenced by the increased attendance. As a matter of fact over 180 were present, and the front of the menu bore for the first time the heading "Osram Lamp and Wireless Valve Works," the addition representing a very important section which is growing month by month owing to the high reputation held by the company's wireless valves in all parts of the world. The dinner was excellent and there was a first-class musical programme, the whole function being ruled by Mr. Wilson with his usual brisk ability. After the loyal toast Mr. Giller proposed "The Firm," to which Mr. Hirst gave a most interesting reply, prefacing his remarks with the statement that the G.E.C. was not a firm but a company. He then gave a brief but wonderfully clear outline of the history of the undertaking from the time when he joined the late Mr. G. Byng and of its present wonderful ramifications, in the course of which he referred to the height to which it had attained, although he feared he could not forecast the height to which it might yet attain. Mr. L. C. Pennell proposed "The Chairman," and also mentioned Mr. Driver, the combined toast being received with much applause, and the replies were duly given, Mr. Wilson creating much amusement by his humorous references to Mr. Fletcher and the sales department, after which Mr. Driver proposed "The Visitors and the Press," for the former of whom Sir Arthur Steel Maitland replied in a speech full of witty epigrams which caused much laughter, while for the latter Mr. S. Rentell expressed sincere thanks for hospitalities so courteously rendered. Mr. Fletcher then proposed a toast not on the menu, viz., "Grateful thanks to Mr. Adams and Mr. Richards," the two gentlemen who were responsible for the successful arrangement of the whole function, and needless to say his remarks were received most enthusiastically by all present. The whole thing went with right good swing and enjoyment, and adds yet another to the list of these happy functions which have now been held for a long series of years.

V.I.R. CABLES—THEIR MANUFACTURE AND SELECTION.*

(Concluded from page 23.)

Mr. W. E. Highfield said he admired very much Mr. Lang's comparison between the art of cooking and that of cable making. It was only after the article was made that you knew whether it was good or only fit for the scrap heap. V.I.R. cables suffered in bad places. He would like to suggest as a test that you get the osmosis and that the moisture be driven in the negative with great violence. Continuing, Mr. Highfield said the difficulties generally arose in protecting the cables from moisture. He thought the history of cable making was remarkable; it had been practically free from trouble, and was a monument to those who guided the destinies of cable making. He also raised the question of cables which were sold to customers after having been kept in stock a considerable length of time. The customer complains the installation is bad, and in many cases requires rewiring. The financial consideration in such cases were heavy, and he suggested that some joint arrangement between the contractor and the cable manufacturers would be beneficial.

Mr. A. Kirk instanced stretching tests he had carried out, generally to four times the length of the cable, leaving it for twenty-four hours, and giving it three hours in which to come back. If it failed, the cable was condemned. In regard to braiding, Mr. Kirk asked what was its use except for holding water?

Mr. F. E. Rooke suggested that as braiding held moisture and occupied space in the conduit, whether a stronger tape could not be substituted for braiding. He was of opinion this would save space.

Mr. W. Lang, in replying, appreciated the troubles experienced by Mr. Alldread, but it would be necessary to see the cables he had had trouble with. It is quite easy to condemn cables which we have found very useful, and one of the reasons one adheres to rubber cables, and in spite of the troubles, is the flexibility and modest price. Only time could prove which are the best cables. There is no test to which cables can be put to ensure a long life. Continuing, Mr. Lang said it would be very instructive to see some of these newly designed cables which can withstand H.T., and until we have had experience of the new cables we cannot judge.

With regard to C.T.S., it filled a great gap, but it could not be expected that C.T.S. could withstand all uses. It had been known to give trouble, but it was acknowledged that C.T.S. has made great advance.

The speaker referred to vulcanisation, and emphasised the importance of cables being fully vulcanised. It was advisable to stick to black outside coverings (said Mr. Lang), because, in red or any other colour, pigments had to be used which departed from the pure coating. A certain amount of wax had to to be used, which was the reason why red and other coloured cables slip more easily in the conduit. Those who use cables without coverings leave much more responsibility on the workmen, and he gave instances where such cables had not given any trouble. There was, of course, a risk of rough usage by workmen.

---

* Lecture delivered by William Lang, M.I.E.E., before the National Assoc. of Supervising Electricians, November 13, 1923.

The lecturer thought the stretching test instanced by Mr. Kirk rather drastic. They usually allowed six hours for the cable to recover up to 25 per cent. of its original length, the stretch being twice the length of the cable.

Mr. F. T. Alldread, chairman of the N.A.S.E., moved a vote of thanks on behalf of the Association, and expressed the appreciation of the work of Mr. Lang. He thought that much information had been gained, especially from Mr. Lang's replies to questions.

Mr. A. Brammer, general secretary, in seconding the vote, congratulated Mr. Lang on the paper he had given. The discussion had not been so lengthy as he would have expected, but there could be no doubt they had all learned from the instructive and well-delivered lecture that evening.

Needless to say, the vote was passed with acclamation, which Mr. Lang suitably acknowledged.

TROUBLES EXPERIENCED WITH DOMESTIC APPLIANCES.

At the meeting of the Informal Section of the I.E.E., on Monday, January 7, Mr. H. M. Barlow was in the chair when Mr. J. W. Beauchamp opened a discussion on this most interesting subject. The opener first made a gentle protest at having been allotted such a subject when he spent so much of his time in assuring people that there are no troubles. He then reviewed the varieties and types of apparatus in use, and showed that such little troubles as are met with are easily curable—some of them arising from minor oversights of design and assembly that are rapidly being eliminated, and most of them from unsuitable application or wrong handling by the user. Here Mr. Beauchamp got on his favourite theme of urging the importance of ready and expert service by the industry's representatives, either the supply authority, the contractor, or the manufacturer.

The output of appliances is very rapidly multiplying, and with quantity production lower costs will come.

He appealed to the assembly to let him have their complaints and objections and he would see that they were passed on to the rightful parents. The large meeting kept the interest going and produced a very useful debate.

Mr. F. Selley told of having over 3,000 cookers installed in St. Marylebone with hardly any trouble.

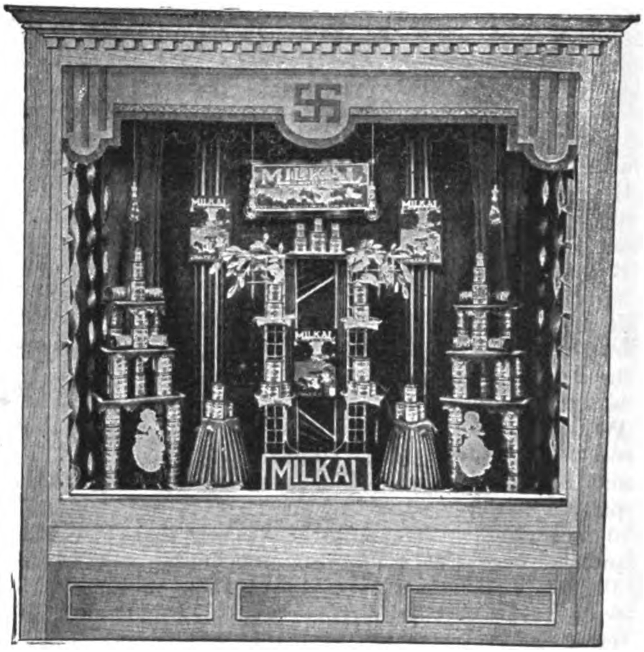
Mr. E. E. Sharp criticised the design of kettles, and asked for a safety device to prevent them burning dry. Information was given that there is a connection obtainable that breaks circuit at this stage.

Another interesting point brought out is that wall-plugs on a skirting often have holes right through the base into the current of damp air behind. Through these holes the draught carries the damp on to the fibre plate of the plug top, and short-circuits have arisen at this point.

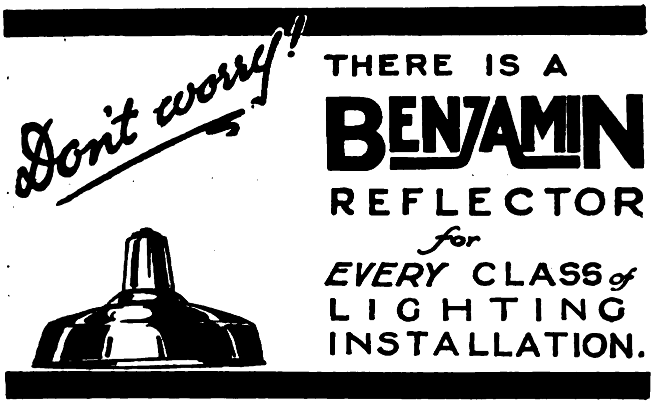
Messrs. D. Betts, A. W. Blake, C. E. Charman, W. R. Fanghanel, R. Grierson, A. F. Harmer, E. W. Lowell, F. J. E. Nesbitt, N. Prentice, M. Pulvermacher and W. L. Wreford also contributed to the discussion which Mr. Beauchamp reviewed and concluded.

AN INTERESTING DEMONSTRATION.

The members of the Incorporated Sales Managers' Association who visited the demonstration rooms of the B. T.-H. Lighting Service Department at 15, Savoy Street, on the 7th inst., were treated to a most interesting lecture by Mr. W. E. Bush, the manager of the department, and also witnessed some remarkable lighting effects as applied to shops and show windows. Space does not permit us to report it at length, and much of the information has already appeared in our columns at various times, but it conveyed a large amount of most useful information which was fully appreciated by all present. The lecture was aided very materially by the use of the B. T.-H. model show window, of which we give an illustration herewith. It enabled Mr. Bush to demonstrate the effect of colour in enhancing the efficiency of a display. This was the first occasion on which this colour demonstration had been given, and in the discussion which took place at its conclusion the general opinion appeared to be that the future trend of show-window illumination would be based upon colour schemes, since it was felt that the attractive power of the show window would be increased 100 per cent.



Two new circulars have just been issued by the **Westminster Tool and Electric Co., Ltd.**, of Westool Works, Putney Bridge Road, London, S.W.15. They deal respectively with Nos. 1 and 1a Universal Electric Drills, which are recommended specially for use in shipyards, locomotive works, foundries, etc., and Nos. 2 and 2a of larger sizes for general industrial work, in which the makers claim that this drill has won for itself a prominent position. The lists, therefore, should appeal to a very wide circle of engineers.


Don't worry! THERE IS A BENJAMIN REFLECTOR for EVERY CLASS of LIGHTING INSTALLATION.

Advert. of the Benjamin Electric Ltd., Brantwood Works, Tariff Road, N.7.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and Abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Tuesday morning, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription : 13s. a year, 6s. 6d. half year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

Kerb Lighting of Pavements.

An esteemed contemporary, *Municipal Engineering*, condemns as unpractical my revolutionary suggestion of a few weeks back that there might be possibilities in a system of illuminating the surfaces of pavements or sidewalks in our suburban districts by means of lamps situated, and adequately protected from damage, in hollow kerbs, after the manner of theatre footlights, but so arranged that the eyes of pedestrians using the pavements were suitably protected from direct glare. The original suggestion did not come from me, but was embodied in a letter from a correspondent, published by another electrical contemporary, which also treated the idea with derision. I am quite open to admit that the idea *may* be impracticable, but there is surely no harm in suggesting any alternative to the present admittedly inadequate and hopelessly inefficient method of street lighting in vogue in so many of our larger towns.

It is my misfortune to have to negotiate a series of streets in a particular suburb which comes under this general condemnation of street lighting, and when no moon is visible to aid the wayfarer the conditions as affecting the unfortunate pedestrian are actually worse than if civilisation had let well alone and natural paths remained. The pavements have been badly laid in the first instance, and the original kerbs have sunk in places until there is no continuity of border or definite edge, whilst the potholes in the roadways and the accompanying mud cast shadows and reflections which are extremely disconcerting even to one who knows the district well by daylight. Applied to such a thoroughfare as this, of which there are many, many miles still extant in these islands of ours, such a system of kerb lighting would be a godsend. One would at least avoid the risk of a badly sprained or twisted ankle, and have light enough to realise whether one was actually walking on the road or the pathway.

Most revolutionary suggestions, whether or no they subsequently prove practicable, are received either with derision or objections at the outset, and in repeating the proposal of the original correspondent, who admitted that he was not a lighting expert, I also disclaim all association with the science of illumination from a technical standpoint. Kerbside lighting may indeed be impracticable; on the other hand, fairly considered and scientifically applied, it might afford a practical solution of the street lighting problem in certain classes of thoroughfare, just as successfully as the present system of intermittent lamps on cast-iron standards lamentably fails, at all events in the particular case I have in mind. I might add that the street lamps in question are fitted with lanterns of a long obsolete type, housing old pattern vertical incandescent gas mantles, which are more frequently broken than whole, and, in many instances, not lighted at all. Yet the local lighting rate is just as heavy as in other well-lighted towns where electricity provides the illumination.

Natural Lighting.

The same contemporary draws attention in a subsequent paragraph to the obvious neglect of natural lighting as furnished by the sun during the hours of daylight. Factory Inspectors are repeatedly commenting upon this neglect, which will be apparent to observant visitors to many factories and industrial establishments, as well as offices, etc. In many cases window space is cramped and partly blocked by stuffed rags and stored materials. In a grinding mill forty-five out of seventy window panes were broken, and the majority covered over with sacking. Other cases are recorded of windows being entirely obscured with paint, or so dirty and stained with oil that natural light penetrated with difficulty.

That daylight is generally superior to artificial illumination, and costs less, will be generally admitted. It is therefore surprising that it should be so neglected. The use of prismatic glass or outside reflectors for basements or overshadowed rooms is recommended, and artistic "colour schemes" for factory walls, although, perhaps, adding to the general cheerfulness of the surroundings, should not be executed in dark colours. The tendency to use thick dulled glass for windows is deprecated, as it not only reduces the daylight, but also collects dirt, and by reason of its roughened surface is more difficult to clean. When one comes to consider the use of natural light in private houses the same neglect of daylight obtains. It is the general practice to dress all windows with fancy curtains or light blinds with the primary object of making the exterior of the house presentable, and preventing passers-by from seeing too much of the interior.

The idea is fundamentally unsound and contradictory. The basic function of windows is to admit natural daylight, to which end glass is employed. This primary function of the average window is enormously discounted by the occupant with the aid of drapery, curtains, plants, furniture, window ornaments, and other light-obstructing objects. It would be a vast improvement on the natural lighting of many interiors and overcome the objection of lack of privacy if some inventor came along with a glass which, whilst preserving its transparency, was opaque to the observer from one side. Such a glass would render curtains unnecessary except for decorative reasons. The almost total exclusion of daylight from some of the older city offices is, no doubt, due to the congested state of the City itself. I know of at least one case of an employé working in a ground floor counting-house in the vicinity of Cheapside by artificial light for over fifty years. Just fancy: he only saw the sun and sky at meal times, or before and after business hours, and that for half a century.

Wireless for the Deaf.

There has been much discussion of late regarding the utility of wireless reception of broadcasting as an aid to the deaf. Last Sunday I had an opportunity of trying out the theory that listening to broadcast speech and music may afford some relief to those unfortunate persons whose hearing, although defective, is not totally destroyed. I invited a gentleman who is stone deaf in one ear and partially deaf in the other one to try the experiment of listening to the afternoon concert from 2 LO. He could just distinguish piano music in the room as repeated on the loud speaker, but, when the head-phone was adjusted to both ears he had no difficulty in following the programme, although I considerably reduced the volume of reception and subsequently left him to adjust matters to his own taste. At the end of the afternoon he discarded the earpieces, and his parting remark was that he believed he had derived benefit from the experiment, in that he could apparently hear other sounds more distinctly than usual immediately afterwards. From this initial trial it would appear possible that the concentration of sound upon the ears of a deaf person for appreciable periods, as in broadcast reception, has the beneficial effect of exercising sluggish or otherwise defective auditory nerves which ordinary sounds fail to sufficiently excite. I hope to continue this experiment, as the patient contemplates installing a set of his own.

Electric Vehicles in France.

I have repeatedly commented upon the inexplicably slow progress of electric vehicles in this country. True there are hundreds to be seen upon our streets—they cannot be *heard*—but there ought to be thousands more. Much the same state of affairs prevails in France, but a vigorous campaign is there being fought by the Society for the Development of Electric Vehicles.

The facts of the case are simple and irrefutable. Also, the immediate advantages of electric vehicles, great though they be, fade into insignificance when compared with the possibilities which "electrics" offer to all branches of the electrical industry.

Simple Arithmetic.

About 70 per cent. of all vehicles used for town and suburban services might advantageously be "electrics," and, from many actual comparisons between petrol and battery vehicles, it may safely be taken that the latter would save 25 per cent. in the cost of such services. A battery vehicle for heavy commercial loads consumes about 30 units a day, or 9,000 units a year of 300 working days. With 20,000 such vehicles in use—which is not too much to expect, either in France or in this country—we have an annual demand for 180 million units.

This would be no small help to the central station industry, to manufacturers of electric vehicles, and, indirectly, to most other branches of the electrical industry. Incidentally, this pitch of development in the use of "electrics" could be reached mainly by substituting them for horse-drawn vehicles. The total field for the "electric" is much greater, but there will still remain a vast field for the petrol vehicle in long-distance work.

ELEKTRON.

A NEW MULTIPLE-RETORT UNIT.

Messrs. the Underfeed Stoker Co., Ltd., have now brought out a new addition to the ranks of the multiple-retort stoker, the "Underfeed Type F," which is of particular interest to the power-station engineer and for the operation of water-tube boilers in general. There is much difference of opinion as to the merits and demerits of the two main types of mechanical stoker in use for water-tube boilers, viz., the improved chain grate (that is, the travelling grate type), and the multiple-retort stoker, and very much depends on the quality of the coal, whilst both these types of stoker will very shortly experience in Great Britain, as they are already doing in the United States, the most severe competition from pulverised coal. Since each boiler plant, in order to obtain the best results, has to be studied on its merits, and no one method will give the best result in each case, Messrs. the Underfeed Stoker Co., Ltd., have placed this new multiple-retort stoker on the market to complete the range available, since they are already, of course, supplying both "Lopulco" pulverised fuel and "Underfeed" travelling grate stokers.

The stoker is operated with mechanical forced draught on the usual general lines of multiple-retort stokers, the air being conveyed from the fan along a main underground trunk in front of the boilers and then to each individual stoker by vertical trunking. Another valuable feature also in the design is that hollow air-cooled furnace blocks are placed at the bottom of the front wall of the installation at the entrance to the retorts and also in the back wall opposite the dumping grates. The design of these grates for the ash and clinker is very effective, the material being allowed to accumulate gradually at the end of the stoker so as to complete the combustion and prevent the passage of any excess air, and by means of a suitable lever the hinged dumping bars are opened momentarily as required, so that a charge of ash and clinker is allowed to fall down into the ash hoppers below. For very large installations a motor-driven automatic arrangement is provided in which the periods of dumping are adjusted as required by the driving mechanism of the motor.

Altogether the "Underfeed Type F" stoker forms a very welcome addition to the multiple-retort stokers on the British market.

Questions and Answers by Practical Men.

RULES.

QUESTIONS : *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS : *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

Commencing with Question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION No. 175.

When working a cinema projector on 200 volts A.C., 50-cycles, using about 15 amperes, with 3-bladed shutter on machine, an intermittent light was produced on the screen. The carbons were burning steadily and not spluttering. By using a single-bladed shutter a good picture was obtained. Can any reader explain this?—"OPERATOR."

QUESTION No. 176.

I have a foot-candle meter and the battery is run down, and, I am told, the meter will require recalibrating. Is this so, and, if it is so, how can I calibrate it?—"ILLUMINATOR."

(*Replies to Questions Nos. 175 and 176 must be received not later than February 2, 1924.*)

Answers to Questions.

QUESTION No. 169.

An additional second prize of 5s. has been awarded to "D. J. Wilson" for the following reply :—

The resistance of all pure metals increases with an increase of temperature. Generally speaking, the resistance of alloys of metals changes less than that of pure metals, but is not so constant, due no doubt to imperfect mixing of the ingredients, and when accuracy is required it is advisable to check the calculations by means of standard meters.

Now the drop in volts varies with the resistance and the square of the current carried, so that in the case under review, as the resistance becomes warm the pressure will fall.

In a like manner, if the current varies, here we have another source of variation of drop in pressure.

These may be counteracted by using a small variable resistance in series with the main resistance, a voltmeter being mounted upon the frame, and by using an alloy resistance wire which possesses a negligible temperature coefficient, this latter method being the better one.

It may be that it is not absolutely essential to maintain the reduced voltage at exactly 25 volts, and in that case the resistance could be so designed that either the maximum or the average voltage was approximately 25 volts.]

Now the approximate resistance of pure metals with varying temperature is given by:

$$R = r\ (1 + ad).$$

Where R = Resistance at any temperature t°C,
r = Resistance at temperature t_0 (0°C),
a = Temperature coefficient,
d = Difference of temperature $= t - t_0$;

which is quite near enough for practical purposes.

It is proposed to deal with three of the commoner metals, and the temperature coefficients per degree C are given in Table 1.

Material.	Temperature Coefficient.	S.W.G. for 15 Amps.
Iron	0.00625	13
German Silver	0.00036	12
Manganin	0	12

TABLE 1.

In the case of German silver, if this is heated for a prolonged period to 150°C the specific resistance becomes constant over a wide range of temperature.

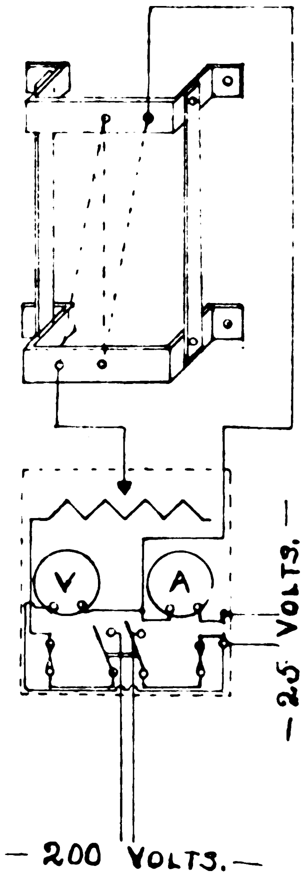


FIG. 1.

Iron is mentioned principally because it is cheap and may be already on stock. German silver will, of course, give a smaller frame, while, of the three, manganin is to be preferred.

The simplest manner of making the coils is to wind them closely upon a parallel mandrel in the lathe, or even in the breast drill to the number of turns shown in Table 2, and then fix them to the brackets shown. These brackets are made from 1½ in. × ¼ in. bar iron drilled to suit the number of spirals.

The holes are bushed with mica tubes and strips of mica are placed on either side of the iron. The bolts are used for connecting the elements one to another, the elements being placed alternately on the front and back sides of the brackets and are shown dotted in Fig. 1.

When the spirals are mounted they will be stretched, the turns being spaced allowing free circulation of air and consequent cooling.

By using this method of mounting and the dimensions given the wire will not exceed blood heat.

If C = Current and R = Resistance then
Drop in volts in the resistance $= C^2R$.

$$\therefore\ 200 - 25 = 15 \times 15 \times R.$$
$$175 = 225\ R.$$
$$R = \frac{175}{225} = 7/9\ \text{w}.$$

Dealing with manganin wire from Table 1, we see that 12 SWG is recommended, which has a resistance of 0.0377 ω per yard.

$$\text{Length of wire required} = \frac{\text{Resistance required.}}{\text{Resistance per yard.}}$$

$$= \frac{7/9}{0.0377} = \frac{7}{9 \times 0.0377} = 20.63, \text{ say 21 yards.}$$

This is cut into three lengths of 7 yards and wound upon a ¾ in. diameter mandrel, each spiral having 54 turns. The length between the supports should be 13 in. Table 2 gives similar details for iron and German silver wire.

Manganin wire should be varnished with shellac after the spirals are made, this will prevent oxidation.

Material.	Number of Spirals.	Turns per Spiral.	Distance between Supports.	Dia. of Mandrel
Iron	8	70	15	⅝ in.
German Silver	5	61	14	¾ in.
Manganin ..	3	54	13	¾ in.

TABLE 2.

The variable resistance shown in Fig. 1 is made by mounting one of the spirals upon a mica tube, a sliding laminated contact producing the variation by means of a screw passing through the iron tube, which support the tube of mica.—" D. J. WILSON."

PROBLEMS IN TELEPHONY, SOLVED AND UNSOLVED.*

BY PROFESSOR J. A. FLEMING, M.A., D.Sc., F.R.S.

(*Continued from page* 18.)

Kennelly and Affel devised an ingenious optical instrument for making measurements of the amplitude of motion of the telephone diaphragm, not only at the centre but at any point on it.

A. E. Kennelly and H. O. Taylor have given a curve (Report on Experimental Investigation read before the American Philosophical Society, April 22, 1915) showing that when a certain Bell receiver was traversed by an alternating current of 2 milliamperes with frequency considerably removed (say by 20 per cent. or more) from the resonance frequency of the diaphragm, the amplitude of motion of its centre was found to be about 0.5 micron—that is 1/20,000 cm or less. This is about equal to the length of the wave of light in the middle of the visible spectrum, viz., about 5,000 Å.U. If the frequency is gradually brought up to the resonance frequency of the diaphragm, the amplitude of motion would be increased 15 or 20 times, say to 7 to 10 microns as shown in Fig. 5. Lord Rayleigh found for a certain receiver that the amplitude of motion of the diaphragm when producing a just audible sound of frequency 256 was 6.8×10^{-8} cm, or only about 7 Å.U.

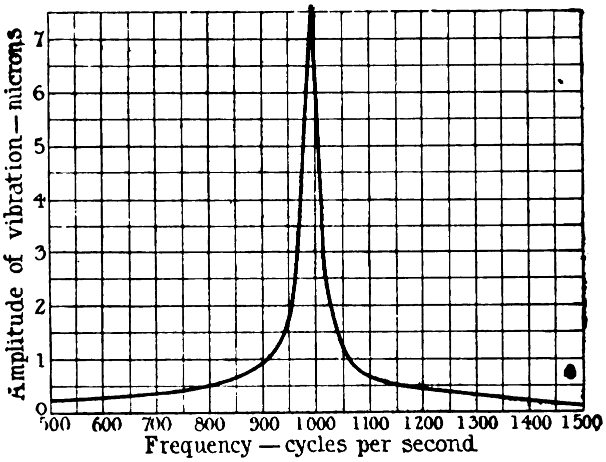


FIG. 5.—CURVE SHOWING THE AMPLITUDE OF DISPLACEMENT OF THE CENTRE OF THE DIAPHRAGM OF A CERTAIN BELL TELEPHONE RECEIVER FOR VARIOUS FREQUENCIES WHEN AN ALTERNATING CURRENT OF 2 MILLIAMPERES IS PASSED THROUGH THE COILS (KENNELLY AND TAYLOR).

P. E. Shaw,* by the use of an electric micrometer of his own invention, found, in very close agreement with Lord Rayleigh, that the amplitude of motion of the diaphragm of a telephone for a just audible impulsive sound, was 7×10^{-8} cm, or 7 Å.U.

Taking the amplitude of the air particle for the just audible sound to an expectant ear to be unity, he found that the amplitude for a non-expectant ear must be increased to 7 or even 70, for a very loud sound to 1,400, and for an overpowering sound to 7,000.

Thus it appears that the amplitude of motion of the air particle near the mouth of a speaker in a conversational tone is about 100 Å.U. or 1/100,000 mm, and the amplitude of motion of the centre of a telephone diaphragm when producing a speech sound just comfortably heard by a normal ear is about 1/20,000 mm. The amplitude of motion of the air particle near the diaphragm is therefore considerably less than that of the diaphragm itself at the centre.

(10) In connection with this part of the subject an important matter is the displacement of the diaphragm at various distances from the centre; in other words, the shape of the diaphragm as it vibrates.

A. E. Kennelly and H. O. Taylor have applied the above special form of optical callipers to this investigation and have given curves in a paper read before the American Philosophical Society in April, 1915, on " Explorations over the Vibrating Surfaces of Telephonic Diaphragms " representing the principal section of the vibrating diaphragm. They have investigated the matter theoretically and compared the results of observations and the predictions of theory. The exact theoretical prediction of the shape of a circular vibrating diaphragm when clamped at the edges requires rather advanced mathematics. I find, however, that a simple empirical formula agrees very well with experimental results. If r is the radius of a circular telephone diaphragm, and if y is the maximum displacement from a flat zero surface of a point on the diaphragm at a radial distance x from the centre and if Y is the maximum displacement at the centre, of the diaphragm, then :—

---

* Lecture delivered before the Institution of Electrical Engineers, to whom we are indebted for the illustrations.

* See *Proceedings of the Royal Society*, 1905, vol. 76 A, p. 360.

$$y = Y \cos^2\left(\frac{\pi}{2} \cdot \frac{x}{r}\right) \quad . \; . \; . \; . \; . \; . \quad (19)$$

Thus, if $x=0$ then $y=Y$, and if $x=r$ then $y=0$, which agrees with the boundary conditions. Suppose we consider the diaphragm in its normal position to be flat and then to be drawn inwards in the centre so that the profile of its principal section is the curve whose equation is given above. The displacements at various radial distances will agree fairly well with the measurements made by Kennelly and Taylor.

(To be continued.)

DEBENHAMS AND THE "RELAY" P.A.B.X.

The Relay Automatic Telephone Co. has manufactured and installed on behalf of the G.P.O., for Messrs. Debenhams' building, 17, Wigmore Street, a private branch automatic telephone exchange of the latest type, which effects its connections in four seconds and gives a continuous day and night service of internal communication together with public exchange facilities on a rental basis. This switchboard has an initial equipment of 400 lines, with an ultimate capacity of 1,270, and the installation has four manual positions, each fitted with 15 cord circuits and positive lamp supervision.

The board is provided with two 32-volt batteries, of 244 ampère-hours capacity, and charging generator, and two battery-driven ringing dynamotors. There are 40 outgoing public exchange lines, and 25 incoming, while facilities are provided for extending the exchange lines to 10 automatic extensions at night.

When completely installed it will be a great deal larger than any P.A.B.X. installation at present existing in the British Empire.

Reviews of Books, &c.

[Books noticed in this column will be sent from ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

BRITISH STANDARD SPECIFICATION NO. 173/1923, FOR THE ELECTRICAL PERFORMANCE OF TRACTION MOTORS (DIRECT CURRENT, SERIES WOUND) (1s. 2d. post free). —This is one of the series of six new specifications which supersede B.S.S. 72/1917, now withdrawn, and is issued by the British Committee, which is the Sectional Electrical Committee of the B.E.S.A.), in response to a request of the International Electrotechnical Commission in May, 1919.

It keeps closely in line with the Rules for Traction Motors of the American Inst.E.E., and the temperature rises specified afford a basis of comparison between motors of similar construction. An appendix has been added, at the request of one of the Overseas Committees of the B.E.S.A., containing notes on the temperature tests specified, and on certain features governing the temperatures of the motors in service, which should prove useful to the purchaser of British Standard Traction Motors.

B.E. STANDARD SPECIFICATION NO. 31-1923 FOR STEEL CONDUITS AND FITTINGS FOR ELECTRICAL WIRING (SUPERSEDING NO. 31-1910). Price 1s. 2d. post free.—The British Engineering Standards Association has issued a new revision of the Standard Specification for Steel Conduits for Electric Wiring (B.S. Specification No. 31), which was first issued in 1906 and revised in 1910.

The following modifications have been made to the original standards, which, it is interesting to note, had been almost universally adopted :—

Two additional diameters have been included, *i.e.*, ½ inch and 2½ inch. In the case of conduit having a larger diameter than 1¹inch the screw threads have been slightly shortened. In other respects the specifications for the conduits remain the same, but a comprehensive range of standards for the fittings used with conduits have been included, together with tests to be applied to the materials used in the manufacture of both the conduit and the fittings.

The use of this specification will ensure the supply of a good practical quality of steel conduit and fittings, and the wider its use the greater will be the benefits.

It will set a standard for the makers, the Government Departments, and for all purchasers of good quality conduit, and the more British standard conduit and fittings are demanded, the better for the electrical industry and the public. It should most certainly be studied carefully by every installation contractor and engineer.

We have received from the Department of Overseas Trade a report on trade in Paraguay, the price of which is 10d. net post free from H.M. Stationery Office or ELECTRICITY Office. Therein it shows that electrical goods and machinery are imported to a moderate extent, and it is to be hoped that English merchants and manufacturers will devote more attention to the possibilities of this trade.

A similar report, price 2s. 9d. post free, deals with the economic and commercial conditions of Australia, and gives considerable information on the subject of the very important hydro-electric developments which are now being carried out, as well as of the electrical developments of the brown coal deposits of Victoria. There is room for a much larger import of electrical machinery, and it is to be hoped that British manufacturers will bear this in mind. At the present time the principal competitors are the United States, with Germany creeping up.

For Sale.—An advertiser has an electrical contractor's business for sale at a moderate figure. For particulars see small-advertisement page.

Smoking Concert.—The smoking concert of the Electro-Harmonic which was held at the Caxton Hall on Friday, the 11th inst., was much appreciated by those who were fortunate enough to be present. Mr. Percy Rosling presided, and the musical programme was of the usual first-class quality.

Various Items.

Brierfield.—The Tramways and Electricity Committee have decided that the charges for electricity be reduced by ½d. per unit for lighting and ¼d. per unit for power.

London-Vienna Wireless.—A wireless telegraph service between England and Austria has been officially inaugurated by the Marconi Co. here in conjunction with the Austrian Marconi Co.

Calendars, etc.—A clearly printed "At a Glance" monthly calendar has been issued by Francis Polden and Co., Ltd., the well-known electrical contractors, of 56, Cannon Street, London, E.C.4, and is certain to be appreciated.

Algeria.—A survey of the commercial conditions in Algeria, Tunisia and Tripolitania has been issued by the Dept. of Overseas Trade, and may be obtained from H.M. Stationery Office or ELECTRICITY Office, price 2s. 9d. net post free. It gives details of the branches of trade in which there is an opening for British enterprise.

Meetings.—There will be a meeting of the North-Western Section (Manchester) of the Junior Inst. of Engineers on Monday, the 28th inst., in the Textile Institute, 16, St. Mary's Parsonage, Manchester, at 7.30 p.m. Paper, "Some Developments in Electricity Supply," by S. L. Pearce, Esq., C.B.E., M.Sc.Tech., chief engineer and manager, Manchester Corpn. Electy Dept.

Argentina.—The current issue of the *Board of Trade Journal* contains an interesting article on the trade outlook in this great republic, and among other things it states that Germany has not yet recovered her pre-war trade in electrical material and appliances, much of which now come from the United States. It is to be hoped that Great Britain will be able to gain and hold this very important business.

The "Model Engineer" Exhibition.—This annual exhibition at the Royal Horticultural Hall, Westminster, was a wonderful success and was attended by very large numbers of enthusiastic amateurs, who showed keen interest in the models which were on view, as well as in the numerous sets of wireless apparatus which had been made by members of the society or were on sale by the leading firms.

Obituary.—We regret to announce the death, on Friday, the 11th inst., of Mr. Thos. Wm. Greaves, after an illness of only a few hours' duration. Mr. Greaves was the managing director of the Wholesale Electrical Co. (1922), Ltd., of 78, Charlotte Street, London, W.1, and had been intimately associated with the manufacture and supply of electrical apparatus for many years.

A New Kelly's Directory.—Kelly's are publishing an entirely new directory devoted exclusively to the electrical industry, wireless and allied trades. The first edition of this book, which will be issued shortly, price 30s. post free, is modelled on the lines of the other trade directories published by them. An interesting feature will be the list of lighting and power undertakings, with the names of the officials, voltages, etc., and there will also be an extensive list of the proprietary articles and trade names throughout England, Scotland and Wales, with the name and address of the makers of each, which should be of the greatest value to all connected with this important and ever-developing branch of industry.

Transformers.—Readers who may wish to purchase transformers up to one kilowatt, or to have them specially built according to their own ideas, will be interested in the advertisement of Mr. Inwood, of Leeds, which appears in our small advertisement page.

N.A.S.E. Annual Dinner.—The annual dinner of the National Assn. of Supervising Electricians will be held at the Holborn Restaurant on Saturday, February 16 next, and we expect that it will be well attended, as the N.A.S.E. is looked upon as a very enterprising and go-ahead society.

Congratulations.—We congratulate Mr. J. Rowan on the fact that he has again been elected secretary of the Electrical Trades Union for a further period of three years. Mr. Rowan has always fought well for the interests of his union, but on the other hand he has also always been ready for frank discussion, and has in many cases shown a spirit of sweet reasonableness which has done much to smooth over matters of dispute between the union and employers. In this respect he has had a sobering influence with various members of the E.T.U. who have held less prominent positions, but have been, to put it mildly, regular firebrands. We hope he will continue to guide the destinies of the union for many years to come.

Plant Wanted.—The Société Nationale des Chemins de fer Vicinaux, of Brussels, invites tenders for the supply and installation of underground cables for the local Brussels-Espinette-Waterloo line.——The N.S.W. Govt. Rys. and Tys. Dept. invite tenders for ironclad switchgear.——The Post and Telegraph Dept., Wellington, N.Z., invite tenders for the supply of screwed bridle rings, vitreous blue enamelled, 5-16-in. opening, corresponding to sample.——The Egyptian Ministry of the Interior invites tenders for the supply, delivery and equipment for a hydro-electric plant for Fayoum.——It also invites tenders for the supply, delivery and erection of transmission lines and distribution system in connection with the above plant.——Specifications, etc., at the D.O.T. (Room 52), 35, Old Queen St., S.W.1.

Internal-combustion Engineering.—An interesting lecture on this subject was given before the members of the Newcastle and District Assocn. of Foremen Engineers on Saturday, January 5, by Capt. W. P. Durtnall, who is well known to our readers as the inventor of the Paragon system of electric ship propulsion. At the close of his lecture Capt. Durtnall urged that research should be directed to the design and construction of suitable internal-combustion engines that would be capable of using our national fuel—coal. But, even if that were done, he was certain that the internal-combustion engine, in its present form, was not nearly so efficient as it could and should be. "I am of the firm opinion," he declared, "that much more should be done in the field of regeneration of the present waste heat from all internal-combustion engines, and in that view, and based on most successful research work, recently carried out, I view somewhat with alarm the coupling direct of internal-combustion engines to the propeller shafts of ships and locomotives."

Trade Notes.

List No. 136 of Starter and Lighting Batteries made by the **Hart Accumulator Co., Ltd.**, is priced at figures representing a reduction of 10 per cent. on previous prices, while the plates have been so improved that increased capacities are now offered. It will interest all contractors, garage owners, etc.

A circular letter issued by the **Benjamin Electric, Ltd.**, under date January 12, announces important price reductions in the company's specialities, as well as pointing out that certain lines have been cancelled and many new and improved devices have been produced since the publication of the company's last general catalogue, for which an amended index has been prepared and issued along with the letter.

ARMATURE WINDING
and
MOTOR REPAIRS
A.C. Work a Speciality.
Re-designing and re-conditioning of any class of motor.
SAMUEL BAXTER,
Electrical and Mechanical Engineer,
158, FULHAM PALACE ROAD,
Phone: Hammersmith 2524. LONDON, W.6

ARMATURE REPAIRS
MARRYAT & PLACE,
28, HATTON GARDEN,
LONDON, E.C.1.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

JANUARY 25, 1924.

CONTENTS.

	PAGE
Patent Application Procedure	39
Control Gear for Electromobiles	40
Electrification of the French Midi Railway	41
Artificial Lighting of Football Field	42
Current Topics	45
The Hogarth 4-Valve Receiver	47
Problems in Telephony, Solved and Unsolved	47
The E.C.A. Dinner	48
A Holophane Demonstration	48
Armature and Coil Winding from a Conversion Point of View	49
Questions and Answers by Practical Men	50
Reviews of Books	51
Various Items	52

PATENT APPLICATION PROCEDURE.

It is found that inventors often have very little knowledge of what is involved in obtaining the grant of a patent to protect their interests. Indeed, this is often the case with those inventors who have arranged for the matters invented by them to be covered by Letters Patent.

Before Letters Patent are granted for any invention it is necessary to file at the Patent Office two documents, an application form and a complete specification.

Application Form.—The application form is essentially both a declaration and a supplication. It must be executed by the inventor, and it may be executed by other parties in addition. The inventor's name must appear in the form, and, if other applicants join also in the application, they must be separated out into those who are inventors of the invention to be claimed and those who are merely joint applicants. This is very important as regards the validity of the British patent, and even more so if one is likely to apply for a patent in the United States of America based on the British patent. A company or body of persons cannot in this country claim to be inventors except they claim in respect of an invention communicated from abroad or unless they be the applicants of a foreign patent on which the British case is based. It is a matter of fact who is the true inventor, and the facts should be correctly ascertained before the application form is signed claiming that any particular person is the inventor.

Specification.—The complete specification must particularly describe and ascertain the nature of the invention and in what manner it is to be performed. It must end with a distinct statement of the invention claimed. Only one invention may be claimed in one complete specification, but more than one claiming clause may be introduced. Although these may be independent of one another in practice, they must bear very close relationship, and the substance of the main claim as a general rule must be incorporated in the subsidiary claims. If this be not done, it is usually held that more than one invention is present. There are exceptions to this, particularly if the difference between the substance of the claims is small and an art come into question which is not highly advanced. The complete specification must be accompanied by drawings, if reasonably necessary, for the understanding of the invention, and these require to be prepared in a special way. This specification has to be drafted in such a manner that it may stand the many attacks that may be brought against a specification in proceedings for the infringement thereof, or in revocation, or, to a less degree, opposition proceedings. It is, therefore, clear that it is not a matter that can be settled quickly, for which reason it is not the practice to lodge this specification at the date of applying for the grant of a patent. For this purpose a shorter specification, called a provisional specification, is more often filed with the application form. This legally need only describe the nature of the invention. On filing this at the Patent Office with the application form, it secures for the applicant a right of priority corresponding to the date of filing. From this date the patent begins, and this is the date that can be claimed for foreign patents in most of the main countries of the world under the provisions of an International Convention.

Although strictly the provisional specification need not be a detailed document, in practice it is well for all the information to be contained in the provisional specification relating to the invention which is in the possession of the inventor at the time. The reason of this is as follows :—

After the provisional specification has been filed, namely, according to the present law at any time up to nine months thereafter, or with an extension fee up to ten months, the complete specification must be lodged. When this is filed it is subjected to a certain examination by the Patent Office. Part of this examination consists in a search and part in comparison between the provisional and complete specifications. If the art be highly developed, such as many branches of the electrical industry are developed, then it may well be that the complete specification is only saved from anticipation by the materials found in the search by matters not contained in the provisional specification. If that be the fact, then the examiners will ask for the cancellation of the provisional specification, and the dating of the application as a whole will be altered to the date of filing the complete specification. This may involve post-dating of nine or ten months, which may be very serious in a branch of science of the character referred to above, because during that time other applications may have been lodged covering the same ground. These may, indeed, prevent the grant of the patent entirely in certain circumstances, or at least they may well render it of little value.

Assuming, therefore, that a provisional specification has been filed in the first instance, the examiners consider this to ascertain that it is properly prepared, contains a reasonable description of an invention, and, if they are satisfied, they accept this provisional specification. It is not published after such acceptance, and, in fact, if no complete specification is ever lodged to follow it, it remains secret.

One of the most important investigations now made by the Patent Office—it always was made to a certain extent—is to see that the specification describes a manner of manufacture. If it relates to a scientific theory only—say, a particular theory of self-induction—an objection is taken by the Patent Office. Often, however, a note of caution is given saying that the matter will be further investigated at the complete stage, for clearly, until the complete specification is filed, in many cases it is impracticable to foresee what an inventor is likely to claim. The objection, however, is well taken in those cases where the provisional specification only describes matters on which no claim could be made to a "manufacture."

When the complete specification is filed, in addition to the general examination as to form, as to seeing that it does claim a true manufacture, and that its claims are both succinct as well as distinct from the body of the specification, an investigation is made among British specifications in the same art covering a period of fifty years prior to the date of the application.

If the examiner should find any which, in his view, wholly or partially describe what is claimed, he brings these to the notice of the applicant, who thereupon must amend his specification. It is found that in practically every case some prior specification is cited by the examiner, and amendment required in view thereof.

In addition to this investigation, specifications of prior date, but which do not pre-publish the application, are examined and brought to the notice of the inventor. (This examination is extended even after the grant of the patent.) These need to be dealt with cautiously in a particular way, and must be strictly taken on their merits, because they can only subsequently be used as instances of prior grant as distinct from prior publication, and, even then, only if valid patents are sealed on them. This is a highly technical point.

Assuming that the complete specification has been amended in such a manner as to fall in with the views of the examiner, and that the provisional specification and application form are likewise in order, the specification is accepted, and from that date it is open to public inspection. Notice of acceptance is shortly afterwards published in the *Official Illustrated Journal of Patents*, and within about a fortnight a printed document containing both the provisional and complete specifications is available. Within two months from the issue of the *Journal* opposition may be raised against the grant of a patent by interested parties on particular grounds. The difficulty that arises here is that, although the Patent Office search during the application proceedings covers only a specific section of the prior art, as explained above, the grounds of opposition are much wider.

After the expiry of the two months' opposition period, assuming no opposition has been raised, or after the opposition has been settled and any appeal from the decision of the Comptroller taken to the Law Officer and favourably decided, a patent is granted.

Accrington.—The electricity undertaking is one of the first in Lancashire in cheap generation. Ald. Higham (chairman) told the Town Council that the total fuel cost per unit was for a recent period 0.298d., and the total fuel cost per unit generated 0.224d The coal pounds per unit generated were 1,884 lb. That was a very good figure, and was not very much improved upon by any other undertaking in the kingdom.

CONTROL GEAR FOR ELECTROMOBILES.

The electric truck for general industrial use is becoming a very general feature of works equipment, and it is obvious, in view of the conditions under which the trucks have to work, that particular attention must be paid to ensuring that both the framework of the truck and the electric equipment shall be of the best design to withstand vibration, sudden shocks, and the rough usage of daily work. In this connection various types of the battery driven trucks built by Electromobiles, Ltd., of Otley, Yorks, have been equipped with motors and control gear of special design, manufactured by the General Electric Co., Ltd., at their Witton works. In their case the electrical equipment is suitable for a current of about 50 amperes when the voltage is not greater than 80, with a specially designed motor of the series wound, enclosed type, built with a cast-steel case. The armature, which runs on ball bearings, has a very large commutator, and brush gear of special robust design—a very necessary feature in machines likely to be subjected to excessive vibration and rough usage. As made, the machines can be liberally rated, so that they withstand for one hour an overload of 100 per cent. without the temperature exceeding 135 degs. Fahr.

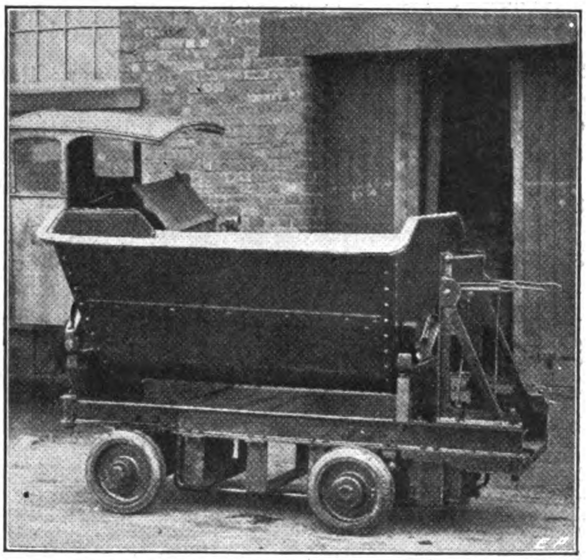


Fig. 1.

The controllers are of the drum type, constructed wholly of metal with mica insulation, and arranged to give three speeds in both forward and reverse directions. On the lowest stop the armature, the two field sections and the starting resistance are all in series. For the second stop the resistance is cut out, and for the first speed the two field sections are changed from series to parellel, and at the same time paralleled with the resistance. A special type of unbreakable and rustless resistance unit is used, and is housed in a suitable protecting cover.

In addition to motors and control gear for the lighter trucks the G.E.C. have designed and built similar gear for the more heavy "Electromobile" trucks and road vehicles for loads from 1½ to 5 tons, as well as for a number of crane trucks built by the same makers in conjunction with the Witton Kramer Electric Tool and Hoist Co. Certain of these designs also embody lifting magnets and magnetic brakes. In our illustrations, Fig. 1 shows a 3½-ton yard truck supplied to the Caledonian Railway, whilst Fig. 2 shows a similar truck with the platform removed to give a clear idea of the arrangement of the electrical gear, and Fig. 3 is a close view of the motor.

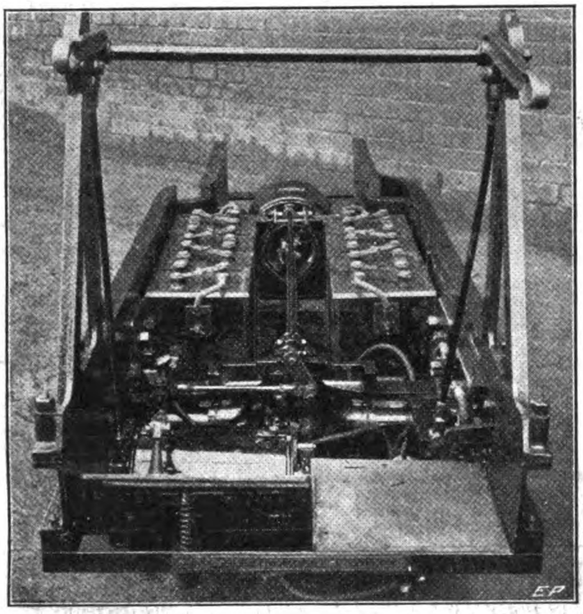


FIG. 2.

Yet another class of vehicle for which the electrical gear has been supplied by the G.E. Co. to Messrs. Electromobile, Ltd., is the Electromobile high lift truck, which embodies some very interesting features, and can render various useful services. Briefly, it can be used with loose low platforms to pick up, carry and deposit loads, or tier them up to six feet or more, so increasing floor space and eliminating congestion. This type of truck can be made in capacities up to 4,000 lb., and is an extremely useful machine for loading from points of varying height into railway wagons, and other forms of vehicle.

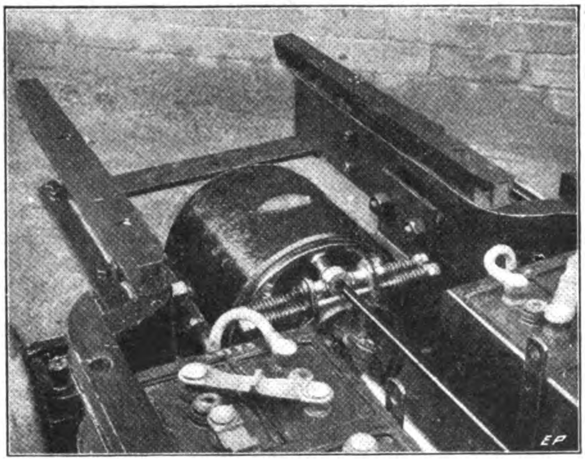


FIG. 3.

ELECTRIFICATION OF THE FRENCH MIDI RAILWAY.*

By A. BACHELLERY, Ingénieur-en-Chef, Chemins de Fer du Midi, France.

The Midi Railway of France extends in the southernmost part of that country from the Atlantic Ocean to the Mediterranean—from Biarritz to Perpignan—along the snow-covered Pyrenees, sending off branch lines up most of the valleys of that chain of mountains. It also runs up north of Beziers across the Cévennes district, a very wild, picturesque and mountainous country.

On account of these features, several of its lines have very steep gradients; grades over 3 per cent. are not infrequent. The difficulties encountered in the working of such lines with steam locomotives, as well as the fact that water-power was close at hand, were bound to place the problem of electric traction very early before the Midi Company.

It began effectively in 1902, when the company undertook the construction of a narrow-gauge line, 35 miles long, from Villefranche-de-Conflent to Bourg-Madame in the eastern Pyrenees, a single-track line climbing to an altitude of 5,000 ft., with long 6 per cent. grades and curves of 200 ft. radius. Electric traction was decided upon, and the chosen system was direct current, third rail, at 850 volts. That was at the time the highest D.C. voltage used in Europe for traction.

The motor-cars (either freight or passenger), with a certain number of trailers composing the trains, were fitted with the Sprague multiple-unit control.

The line was opened in 1910, and has since worked to the entire satisfaction of the company, carrying a relatively heavy traffic to which the construction of the great mountain resort of Font-Romeu has substantially contributed.

When the line was built, it was considered an optimistic view to expect an annual return of 5,000 francs per mile. It is actually 40,000 francs, although the fares have been increased only from 100 to 150 per cent.

In the meantime the company had been led to consider electrification of lines of normal gauge in connection with proposals for new railways in the Pyrenees; among these, two lines, crossing directly through the chain into Spain, involved, besides tunnels several miles long, gradients of over 4 per cent.

At this time—namely, between 1908 and 1910—the single-phase system had made sufficient progress to be considered as reliable practically, and the use of overhead construction and a high voltage seemed to secure the most economical installations.

In order to verify this through extensive tests, the company equipped 15 miles of line between Ille and Villefranche-de-Conflent. Six different systems of overhead construction—all based on the catenary principle—were effectively applied on this section.

The type of current was single-phase, 16 cycles, 12,000 volts on the contact wire.

Six locomotives, built by different constructors according to the company's requirements, were submitted to a series of tests, and three of them, having successfully passed such tests, were accepted.

---

* Paper read before the I.E.E. on November 22, 1923

It was accordingly decided to equip with the single-phase system 70 miles of double track between Pau and Montrejeau, and the single-track branch lines of Pierrefitte, Bagnères-de-Bigorre, Arreau and Luchon, measuring 63 miles. For this purpose a power-house was built at Soulom equipped with six 2,500 kw. generators. Orders were also placed for 30 motor-cars, each of 500 horse-power, and for 24 new locomotives.

The tests revealed serious trouble in the telegraph and telephone lines along the track, due to inductive interference by the single-phase traction current.

This question was closely investigated by the Midi Company, and a solution was found which consisted in two extra wires run beside the trolley wire, namely:

(1) A negative feeder along which the return current is forced by means of booster transformers, instead of going back through the track rails.

(2) A counter-voltage wire in which there is an alternating voltage directly opposed to that in the trolley wire.

(To be continued.)

ARTIFICIAL LIGHTING OF FOOTBALL FIELD.

An interesting and highly successful experiment has recently been carried out by Messrs. Siemens and English Electric Lamp Co., Ltd., in connection with the artificial lighting of a football field by electric lamps.

The installation, which was designed by the Illuminating Engineering Departments of Siemens and English Electric Lamp Co., Ltd., and the Benjamin Electric Co. in collaboration, was erected on the Burnley Cricket Club ground at Burnley, Lancs, for a night match between Dick Kerr's Ladies (Lancs Champions) and Key's Ladies (Yorkshire Champions). It consisted of Benjamin reflectors used in conjunction with Siemens' 1,500 watt and 500 watt gasfilled lamps, the arrangement being as follows:—

Eleven 30-ft. wooden poles were erected (26 ft. above the ground) along either side, spaced 33 ft. apart, and four similar poles along either end.

The side poles carried Benjamin angle parabolic reflectors mounted at the top and fitted with 1,500 watt Siemens gasfilled lamps, 5 ft. lower down Benjamin elliptical angle reflectors with 500 watt Siemens' gasfilled lamps.

The end posts had Benjamin concentrating type reflectors with 1,500 watt lamps, mounted at the extreme top.

The result was extraordinarily good illumination to the value of 7-ft. candles all along the touch line, 2½-ft. candles 30 ft. in from the posts, 2-ft. candles 60 ft. in, and 0.5-ft. candles in the centre of the field of play.

There was an entire absence of glare, since the top reflectors were above the line of vision, and the lamps and reflecting surfaces of the elliptical angle reflectors were quite invisible, due to the very efficient design of these fittings.

The concentrating reflectors at either end of the field lit up the goals and corners without the slightest trace of glare.

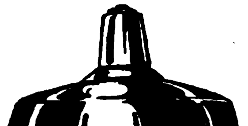
The illumination was very even with no trace of any shadows.

The players, though slightly handicapped by a fall of snow which started just before the match and continued right through the game, unanimously expressed approval of the effect of the lighting on their play.

Dick Kerr's ladies pulled off the match with a win of 5 goals to 1.

The very apparent success of the whole arrangement shows the possibilities opened by the scheme, and we may therefore hope to witness league football matches under similar conditions. This is the first time that a recreation field of the size of a football field has been successfully illuminated electrically in any part of the world. Several attempts have been made, particularly in America, but difficulty has always been to illuminate shadows. This defect was successfully overcome in the installation described above, and there is no doubt it marks an epoch in electric illumination.

The Society of Engineers.—The October-December issue of the *Journal and Transactions* of this Institution contains some excellent articles, including a well-illustrated paper on the "Automatic Production of Glass Bottles," contributed by Mr. Alexander Ferguson, and a first-class treatise on "Lubrication," contributed by Mr. Wm. Lee. The latter should be of direct interest to all central station engineers, to whom lubrication and friction represent very important items in the efficiency and maintenance of electrical machinery.



Don't worry! THERE IS A BENJAMIN REFLECTOR for EVERY CLASS of LIGHTING INSTALLATION.

Advert. of the Benjamin Electric Ltd., Brantwood Works, Tariff Road, N.7.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principle Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and Abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Tuesday morning, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription : 13s. a year, 6s. 6d. half year, 3s. 3d. a quarter in advance, postage] prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

The C.T.S. Competition.

I suppose many of my readers are now busy putting the final touches to their papers which they will be sending along for the five-guinea C.T.S. prize, of which particulars have already been given in several issues. It is, however, quite possible that since the New Year fresh readers have come along who may have just missed the issues containing the details of the competition, and for their guidance I would refer them to ELECTRICITY for January 4, in which they were given at length. Even a guinea is acceptable in these hard times, so there is plenty of scope for the enterprising electrician, whether he be a contractor, foreman, wireman, or apprentice, and I shall be keenly interested in seeing which towns in Great Britain secure the biggest prizes. So I trust every reader who enters will do his best, and put up a good fight. The more the merrier !

Colour Schemes.

The use of colour as an attractive medium from an illuminating engineering point of view appears to be progressing very rapidly, and I think we are on the fringe of great discoveries in this respect. That colour has various influences upon our moods is undoubted, but it is no new innovation when one considers that the ancient Egyptians took the greatest possible advantage of colour. The three primary colours, red, blue and yellow are greatly in evidence on the beautiful designs of coloured work that have been handed down to us, or discovered from time to time. As a matter of fact, the ancient Egyptians looked upon colour as a force. They claimed that the effects of red assisted to convey the impression of warmth. This probably accounts for the fact that when one is sitting in front of a non-luminous electric radiator, the temperature appears to be absent because the " red " cannot be seen.

That there is something in colour schemes is evident from the fact that oftentimes our great-great-grandmothers had several rooms in the house decorated from a colour point of view. One was the blue room, another the white room, another the red room, and so on

That colour has an influence upon one can be easily demonstrated, if one places their hands first under an artificial daylight unit and then under a unit delivering red light. With the artificial daylight unit the hands decidedly appear to be, and actually feel, cold, while with the red light a sense of warmth is experienced

The effect of colour as an attractive medium can easily be discerned if one stops to notice persons looking in well-known shop windows during the day-time. Windows exhibiting white or black goods, or even a mixture of the two, are practically deserted, while a shop window display in coloured goods is the centre of attraction. It is not generally known, however, that under the influence of coloured light the beauties of colours are enhanced, and are, therefore, made more pleasing to the eye. It appears to me from what I have recently seen that with the aid of good light and judicious colour schemes in the home, the beauties of the home furnishings can be made to stand out more effectively. The effect is undoubtedly artistic, so much so, that in the near future it will not surprise me to hear that light is an essential in the furnishing of the home.

Illuminating Experts.

Judging by the examples one constantly sees of ill-considered lighting schemes, both in private houses and business establishments, shop window, etc., there is plenty of scope for an extensive practice by consultants on illumination in practically every district where electric lighting is in vogue. Without drawing upon my memory to any appreciable extent, I can cite at least six examples of extremely bad lighting effects in as many different locations which I have visited during the past week, and there must be literally thousands of similar cases in every town. Only last Sunday I visited some friends who have recently moved into their present house and have installed electric light. The host is a dentist, and both his surgery lights, a pendant fitting from the centre of the ceiling and another pendant immediately facing the operating-chair, are equipped with gasfilled units entirely unshaded.

In a private sitting-room on the first floor is a central pendant fitting with a very pretty Japanese shade. The lighting unit is a 50-watt gasfilled, and again the level of the lower edge of the shade is such that anyone seated, in no matter what part of the room, receives the glare directly in the eyes. It was perfect misery to sit in that room for any length of time, and I pointed out to my host and hostess what a simple alteration was involved to convert lighting misery into illuminating comfort. Again, take a tram or 'bus which passes along a series of thoroughfares bordered on one or both sides with shops, and note the proportion of shop windows in which the lighting units are directly visible to the eye of the observer on the pavement. I know of one route which I frequently travel where only about one shop window out of twenty has adopted the correct principle, and shaded its light from the direct view of the passer-by. Needless to add, those few shops convey the most pleasing effects of any when illuminated after dark, and that quite irrespective of the nature of the commodities displayed.

Another example concerns a busy office, tenanted by a small staff of perhaps eight clerks. The roof is lighted by one central bowl fitting, and the scheme adopted relies almost entirely upon reflection from the whitened ceiling, the lighting being of the semi-indirect order. As a room of leisure the lighting is, perhaps, adequate, but for business purposes the resultant illumination is wholly inadequate, and must prove a great strain on the eyes of the several clerks. I have myself attempted to do some writing and checking of figures in that same office, and soon found the inadequacy of the lighting imposed a serious strain on my sight, necessitating an obvious effort to distinguish individual figures and words in ordinary print.

With such a perfect illuminating agent as electricity available in so many districts, it is a great pity that electrical contractors and others interested in wiring houses and other premises for lighting do not take a closer interest in the disposition of the individual lights, their effective shading, and the choice of candlepower for various requirements. The Illuminating Engineering Society has done, and is still doing, invaluable work in its own sphere, as are also the advisory staffs of one or two of the leading lamp-making concerns. Unfortunately, the activities of these experts do not extend far enough, for the simple reason that they are not in personal touch with the average user of electric light, who is thus at the mercy of any incompetent or disinterested contractor or wireman, whose only desire is to get all his points decided to the tenant's satisfaction, and finish the job in the shortest possible time, regardless of the ultimate effects.

It should be the aim of every reputable wiring contractor to turn out a lighting installation which conforms to accepted scientific principles in modern illumination. Such a job need be no more costly than one planned without regard to the first principles of lighting, as so many of them are. When one compares the two installations, however, the difference is apparent immediately the lights are switched on. The one planned by the illuminating expert demonstrates that some brain and intelligence has been at work in the lay-out stage, whereas the other installation marks the duffer who has never qualified beyond the pliers and soldering-iron stage of house wiring. Healthy co-operation between the N.E.C.T.A. and the Illuminating Engineering Society might do some good in the way of educating the trade generally up to better lighting ideas. At present it appears to be outside the scope of the average wiring contractor's responsibilities to his clients.

Broadcasting. Broadcasting still continues to make headway, and there are indications that the slump which we experienced last year will not be repeated during 1924, except, perhaps, by a noticeable reduction in activity during the midsummer months. Much of the present revival of interest is due to the unceasing efforts of the B.B.C. to improve their concerts and the quality of their transmissions. As a regular listener I can testify to the really marked improvement in transmission over a comparatively brief period. Only last Saturday I heard perfectly the whole of Acts 1 and 2 of "Pagliacci," relayed from the Royal Opera House, Covent Garden, to Manchester. The result was highly enjoyable, and deserves a tribute to the technical skill which rendered it possible. Similarly, the recent speech of the Rt. Hon. Stanley M. Bruce, M.C., Prime Minister of Australia, was relayed from the Hotel Cecil, and every word of a peroration lasting well over an hour by the clock was clearly audible some 200 miles away. Moreover, one got the true impression of space surrounding the speaker, and it was obvious to the listener that he was speaking in a large hall, rather than at the usual B.B.C. studio.

There is still a problem or two to be solved before broadcasting can be said to be perfect, and among the present drawbacks the interference caused by near-by spark stations is one of the most pressing, especially in sea-port and coastal towns, where there is considerable spark telegraphy going on practically all day and night. By a curious coincidence, too, those tapper-key fiends always seem to strike up just at the critical moment when one wants a particularly quiet ether to pick up some interesting news item, or musical selection. Spark stations were there first, and they perform an invaluable service; but, from the near-by listeners' point of view they are anathema. One can tune them out by frame aerial at the expense of considerable volume, and some other alternative would be welcomed by residents in the vicinity of some of the more powerful spark stations.

Coal. Labour troubles are said to be imminent in both railway and mining circles. In the former connection it may interest readers to learn the effect upon output of coal mines of the seven-hour day as compared with the eight hours originally worked. Omitting the counties of Northumberland and Durham, where the hours of working were unaffected by the Act of 1919, and contrasting the output for 1913 and 1923, the following statistics are available. In 1913, 884,000 persons, working eight hours a day, produced 231,059,000 tons, or 261.3 tons per person employed. In 1923, 928,500 persons, working seven hours a day, produced 224,787,600 tons, or 242 tons per person employed It will therefore be seen that although the average number of persons employed has increased by nearly 45,000, the number of tons produced has fallen by over six millions, and the production per head by nearly 20 tons, representing over three weeks coal getting by every employee. If household coal is anything to go by, the quality of coal doled out to us to-day is also materially lower than that of 1913. The last load delivered into my coal cellar included some 20 per cent. of heavy incombustible stone, to which my local dealer is welcome for road-making purposes.

ELEKTRON.

Leaflet T 106 illustrates and describes some of the types of transformer made recently by the **Foster Engineering Co., Ltd.**, of Wimbledon, and it also celebrates the completion of the 50,000th transformer. Let us hope the company will not take half as long to reach the 100,000th.

THE HOGARTH 4-VALVE RECEIVER.

International Motors, Ltd., of Bloemfontein Avenue, Shepherd's Bush, London, who have for some time sold Ford cars, have also a large department dealing with wireless apparatus, and in this connection they have recently put on the market a 4-valve receiver which gives astonishing results. It consists of one H.F. amplifier, one detector, and two L.F. amplifiers. The H.F. and the detector valve have separate filament resistances, but the two L.F. amplifiers have one filament resistance operating the two valves. The aerial tuning circuit is loose coupled to the receiver by means of a 180 deg. vario coupler which is wound with No. 22 D.C.C. wire on threaded ebonite formers which allow the turns to be spaced and pile wound, thus lowering the self-capacity to the minimum. The primary coil is tapped at nine points for tuning the aerial, and the secondary coil is tuned by a .001 m.f.d. condenser. The H.F. amplifier is of the tuned anode type, and reactance is coupled to it by means of another 180 deg. vario coupler similar to the one used for the aerial tuning. This, however, is tuned by a .0003 m.f.d. condenser. The stator of this vario coupler is the anode coil, and the rotor is the reaction. This combination is highly sensitive and wonderfully selective. The condensers are of the Polar type and the transformers used are of Silvertown manufacture. The valves are visible through windows and are enclosed in the receiver, as are also receptacles for plugging in loading coils for long-wave reception. The only terminals visible on the front of the apparatus are those for the telephones or the loud-speaker. The battery connections, earth and aerial, are fitted at the back of the case. The selector switch of the aerial tuning coil, when in its zero position, connects the earth and aerial together.

All the connections inside the receiver are of heavy gauge copper, and all joints are soldered. The connections of the rotors in the vario couplers are of the pig-tail type and do not depend on friction.

The operation of this set, although there are six controls apart from the filament resistances, is simplicity itself. The selector switches of the aerial tuning inductance and the anode coil are placed in an approximate position, and the reaction dial is placed at the full position, and then the condenser knobs are turned until a faint whistle is heard. The reaction coupling is then loosened until speech or music is heard, and a very slight adjustment of the condensers will bring the volume of the signals up to loud-speaker strength.

It may here be noted that a 100-volt H.T. battery is used with this set, 50 volts being placed across the first L.F. amplifier and about 90 volts across the second. The chief claim with this set is that signals when properly adjusted are absolutely distortionless and that it is the most selective set on the market.

Tenders Accepted.—The tenders of the Edison Swan Electric Co., Ltd., have been accepted by the L.M. and S.R. for gasfilled lamps; the R.M.S.P. Co., for part contract for metal and carbon filament lamps; the L. and N.E.R., for metal filament lamps; the G.W.R., for gasfilled lamps; and the War Office, for inert cells.

PROBLEMS IN TELEPHONY, SOLVED AND UNSOLVED.*

BY PROFESSOR J. A. FLEMING, M.A., D.Sc., F.R.S.

(*Continued from page 37.*)

Louis V. King, in an article in *The Year Book of Wireless Telegraphy* for 1919, made deductions from some of the measurements of Kennelly and Taylor, which agree substantially with those of the author respecting the acoustic efficiency of the magneto-receiver.

Here, then, is the chief unsolved problem of modern telephony, viz., the invention of a receiver acoustically more efficient than the present type of magneto receiver, and with equal or better speech-reproducing power.

The chief sources of the inefficiency of the magneto telephone receiver are:—

(1) Joulean heat loss in the coil;

(2) Eddy-current losses in the diaphragm and pole-pieces;

(3) Magnetic hysteresis losses in the same;

(4) Mechanical work done in bending the iron diaphragm; and

(5) Vortex motion or frictional losses due to air movements which do not contribute to wave production.

Whilst considerable improvements have been effected it is difficult to see how any great improvement in efficiency can take place without radical departure from the fundamental principles of Bell's invention. In the well-known telephones of S. G. Brown the iron diaphragm of the Bell receiver is replaced by a steel reed tuned to a certain frequency. The magnetic pull of a permanent part of the field magnets takes effect on this reed, which is capable of adjustment. To the reed is attached an aluminium cone with a flexible rim which plays the part of the diaphragm. This diaphragm only partakes of those movements of the reed which are due to the telephone currents, so that, when no speech currents are being received, there is no strain on the diaphragm. Also, by reason of the material being aluminium, magnetic losses are absent. No doubt this type of receiver possesses a somewhat higher acoustic efficiency than the Bell, but I have not been able to find any determinations of it by independent observers.

Apart from the energy losses in the telephone, another defect from one point of view is that its diaphragm has such a marked resonance for a frequency lying in the middle range of the voice. The amplitude of vibration is greatly increased at this resonance frequency and hence speech distortion occurs. In the human ear the tympanum is small and has a very high natural frequency. The result is that it can respond to those high harmonics which, as we have seen, give quality to the sound, especially consonantal speech sounds. Having regard to the enormous public use of the telephone, not only in ordinary telephony, but in radio-telephony, where the available power is limited, the improvement of the acoustic efficiency of the receiver is one of the most important problems that can engage scientific attention. As it stands, the telephone receiver is by far the most inefficient of all our electrical energy-transforming devices.

---

* Lecture delivered before the Institution of Electrical Engineers, to whom we are indebted for the illustrations.

(11) The only forms of practical receiver for telephony which have so far presented themselves as just possible alternatives to the electromagnetic or Bell type are those depending (i) upon thermal actions, (ii) on electrostatic attractions, and (iii) upon variations in the friction or adhesion of certain material, produced by the action of small currents or differences of potential.

An example of a thermal receiver is that of MM. de Lange and Fischer, which was described in a paper sent to the Royal Society in 1915.*. It consists of a loop of very fine platinum wire or very thin strip of gold or platinum enclosed in a tube or capsule with exit holes. When telephonic speech currents are sent through the wire it is heated, and the sudden expansion of the surrounding air generates sound waves which make their exit from the holes. This chamber may take the form of an ebonite capsule which is placed in the external orifice of the ear. This appliance has been much studied in the United States as a precision source of sound. H. D. Arnold and I. B. Crandall have obtained mathematical expressions connecting the heating current and air pressure changes for certain forms of the instrument.† Another theoretical paper has lately been published on it by E. C. Wente.‡

Although this thermophone is of service in the research laboratory, it has not yet replaced in any way the Bell magneto-receiver in practice.

(To be continued.)

THE E.C.A. DINNER.

On Tuesday, the 15th inst., Mr. Robert Robson, M.I.E.E., the president of the Electrical Contractors' Association, together with the allied N.E.C.T.A., Ltd., and N.F.E. Association, occupied the chair on the occasion of the Annual Dinner, and was supported by a record attendance of members and visitors. The dinner and musical programme were both excellent, while the speeches also were well above the average. The toast of "The Allied Associations" was ably proposed by Sir James Devonshire, K.B.E., who referred to the three associations as a trinity in unity, and remarked jokingly that it was the first time he had had the honour of being the guest of a trade union. He made humorous references to the E.C.A. Year Book with its sixty pages of advertisements and sixty pages of index, while the remaining 240 were very interesting as regards the endeavours made to smooth the relations between masters and men. As treasurer of the I.E.E., he said the E.C.A. were most welcome as tenants at Savoy Street "as long they paid their rent regularly." As chairman of an important committee he was much indebted to Mr. Tate for work and assistance most willingly rendered, and he also spoke highly of the harmonious working with Mr. J. Rowan, the secretary of the Electrical Trades Union, concluding with an eloquent reference to the abilities of Mr. Robson, the president of the E.C.A., whose name he coupled with the toast In reply, Mr. Robson made a most interesting speech, in the course of which he quoted certain remarks of Abraham Lincoln on the subject of moulding public sentiment. He said that it was up to the members of the association to teach the public the multitudinous uses of electricity and not leave it to others. He looked on this as empire year, with Wembley attracting its millions from all parts of the globe, much to the advantage of our industry. Contractors must all try and persuade merchants to supply British-made electrical goods. They must also do their best to keep on good terms with the supply authorities, with whom he thought negotiations were now much easier. The suggested plan for the voluntary registration of contractors was now almost in being, and a few weeks should see it in working order. Reference was also made to the medals awarded to boys who passed certain City and Guilds Exams., after which Mr. Robson alluded with regret to the fact that Mr. Marryat had felt compelled to give up the editorial chair of the *Electrical Contractor* after twenty-one years' service, and on behalf of the association he then presented him with the furniture for a lounge and a diamond star for Mrs. Marryat. For these presentations Mr. Marryat returned thanks in suitable terms, stating that he had been amply repaid by the many friendships he had made during the period referred to.

The important toast of "The Guests" was then proposed by our old friend Mr. W. R. Rawlings, who said lots of nice things about the visitors present, including the Press, and to which very able replies were given by Sir John Snell, who was most optimistic about the demand for current and the industry generally, and also by Dr. Alexander Russell, president of the I.E.E., who pleased all in the room by saying that in his opinion the status of an electrical contractor was never higher than at present. Mr. Marryat proposed success to the "E.D.A.," which was doing so much in aid of the electrical trade generally, and Mr. W. B. Woodhouse replied, after which Mr. H. T. Young made various kindly remarks about the chairman, and Mr. Robson expressed his thanks briefly. Auld Lang Syne and the National Anthem closed a very pleasant evening.

A HOLOPHANE DEMONSTRATION.

We were present recently at a demonstration of colour filters at the showrooms of the Holophane Company in Elverton Street, Vincent Square, and vivid impressions are thereby created upon our minds of the possibilities of colour in the cinema. There is no doubt that the average cinema theatre should make matters more comfortable for their patrons. When one visits a cinema theatre there is the usual groping for seats, although the attendants, as a rule, assist one to the best of their ability. Again, between pictures, there is usually a tedious wait while films are being changed. The units we saw at the Holophane demonstration not only supply an adequate amount of coloured light which will enable one's passage from the door and seat to be negotiated safely, but the vision is not interfered with in the slightest degree. With reference to the colour filters shown, one of them, "Morning, Noon and Night" in the desert was very impressive. It is just the thing which will be appreciated by an audience "between pictures." The Holophane Company will be pleased to receive parties and demonstrate these colour effects to them.

---

* See *Proceedings of the Royal Society*, 1915, vol. 91 A, p. 239.

† See *Physical Review*, 1917, vol. 10, p. 22.

‡ See *Physical Review*, 1922, vol. 19, p. 333.

ARMATURE AND COIL WINDING FROM A CONVERSION POINT OF VIEW.

By C. SYLVESTER, A.M.I.E.E., A.M.I.MECH.E.*

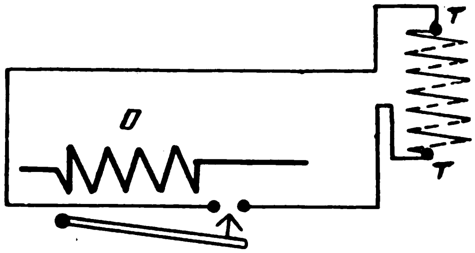
(*Continued from page* 30.)

The fact that a number of ampere turns can be increased on the no-load coil of a motor starter, without appreciably decreasing the shunt current of the motor, has been taken advantage of, especially in the early days when the Home Office Regulations were framed with the object of reducing accidents in machine shops. At that time individual machines were not separately motor driven, it being the usual practice to drive a length of shafting, to which as many as a dozen machines were attached, with one large motor. Owing to the large number of accidents which occurred at the machines it was found to be necessary to issue regulations which demanded that the motor could be stopped as desired from several positions in the machine shop.

The no-load coil of a motor starter is, essentially, to hold the starting arm in position when the motor is running. It is held against the tension of a spring, so that if, for any reason, the magnetism of the coil should be decreased to any extent, the spring, coming into operation, would return the arm to the "off" position again. It was considered, therefore, that the best possible method of stopping the motor from various positions in the machine shop would be to short-circuit the no-load coil. How far this idea was successful will be clear from the following considerations.

The combined effect of the no-load and overload coils in a motor starter bring the starting arm to the "off" position in the case of an overload. This is brought about, in the first place, by the overload coil, which, in attracting the armature, causes the no-load coil terminals to be short-circuited. This is illustrated in Fig. 3. Here *O* is the overload coal, *N* is the no-load coil, and *T T* are the no-load coil terminals. It will be noticed that the leads connecting *T T* are of no great length, and their resistance may, therefore, be neglected, so that it may be said that, when *T T* are short-circuited, the whole of the no-load current is shunted, and the magnetism of the no-load coil is, therefore, reduced to zero.

FIG. 3



From this it will be gathered that one obvious way to reduce the magnetism of the no-load coil will be to short-circuit the terminals *T T*. Let us, however, consider Fig. 4 for a moment. This diagram illustrates a circuit of three pushes (*P*) in parallel, so that, if any one push is pressed, there are two circuits in parallel, one through the no-load coil and the other through the push.

Now, the no-load coil has a definite resistance, and the leads which connect *P* to it also have a certain resistance, the latter depending upon their length and cross-sectional area. It is the resistance of the push circuit which controls the amount of current through the no-load coil, that is, if the no-load coil and the push circuit have equal resistances, then the amount of current through these circuits will be equal. Similarly, if the resistance of the push circuit is greater than the no-load coil circuit, then the amount of current through the latter will be increased. From these considerations it will be seen that there is a limit to the length of the leads which connect *P* to *T T*, since, if their resistance is too high, then the amount of current through them will not be sufficient to weaken the magnetism of the no-load coil to an appreciable extent, and the system will remain inoperative.

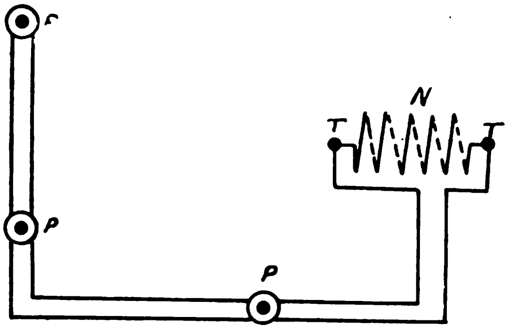


FIG. 4.

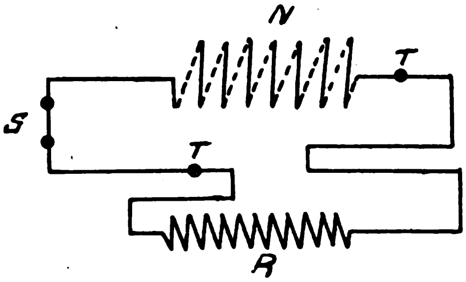


FIG. 5.

There are two sound methods of overcoming this difficulty, the first one being to rewind the no-load to a higher resistance. This will allow a corresponding increase in the resistance of the *P* circuit for a desired amount of shunted current. The second method is to fit a permanent resistance (*R*) in parallel with the no-load coil, so that the no-load coil circuit may be broken without breaking the shunt field circuit. The latter method is illustrated in Fig. 5. Here a switch (*S*) is placed in series with the no-load coil, or any number of switches may be placed in series for that matter, each switch being fitted in any desired position in the machine shop. When the switch is broken the whole of the shunt field current is shunted through the resistance, and the magnetism of the no-load coil is, therefore, zero, and the starting arm falls to the "off" position. It is possible—in fact, very probable—that the no-load coil may have to be rewound with a smaller wire, but, as previously shown, this does not alter the value of the shunt current, and in this case the cross-sectional area of the wire need not receive serious consideration, since the amount of current through the no-load coil is now considerably reduced.

(*To be continued.*)

---

* "Armature Winding," by Mr. C. Sylvester, is a clearly written practical work for the armature winder. It may be had for 8s., post free, from ELECTRICITY Office.

Questions and Answers by Practical Men.

RULES.

QUESTIONS : *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS : *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

Commencing with Question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 175.

When working a cinema projector on 200 volts A.C., 50-cycles, using about 15 amperes, with 3-bladed shutter on machine, an intermittent light was produced on the screen. The carbons were burning steadily and not spluttering. By using a single-bladed shutter a good picture was obtained. Can any reader explain this?—"OPERATOR."

QUESTION NO. 176.

I have a foot-candle meter and the battery is run down, and, I am told, the meter will require recalibrating. Is this so, and, if it is so, how can I calibrate it?—"ILLUMINATOR."

(*Replies to Questions Nos. 175 and 176 must be received not later than February 2, 1924.*)

Answers to Questions.

QUESTION NO. 170.

I desire to make a testing board suitable for testing motors, elements, etc. The supply is 200 volts. Can any reader tell me what instruments and apparatus I shall require, and method of mounting?—J. R. WOODHATCH.

REPLIES TO QUESTION NO. 170.

The first prize (10s.) has been awarded to "D. J. Wilson" for the following reply:—

Much will depend upon whether the testing board is meant to be moved from place to place or fixed permanently in the workshop.

If it is required to be moved from place to place, then perhaps the simplest method will be to connect two lamps in parallel and mount them by means of batten lampholders on to a 6 in. by 6 in. patrass. Two fuses and two terminals should be fitted, a leather strap fixed to the beading will serve as a handle.

Connect as follows: Terminal to fuse, from fuse to lamps, from lamps to second fuse, from second fuse to second terminal.

The testing contacts may be made by driving the eye end of sacking needles into file handles, the test leads being soldered to the needles and the other end being fixed to the terminals.

In testing a motor it would be used as follows: With the motor switch closed, place test contacts on the brush rocker to determine whether or no the supply be in order. If not, take test board to fuses and place one test lead on each fuse-holder at the incoming side; if in order, place one test contact on the live side and the other on the load side of the other fuse. If O.K., reverse positions of test contacts and try again, thereby locating faulty fuse.

To test for continuity of the field, pass supply into field coils and connect board in series with coils.

To test for earth, place one test contact on the frame and the other on first one and then the other brush box, the D.P. switch being closed.

Elements would be tested in a similar manner for continuity to that described for field coils.

A useful workshop earth testing set may be made by mounting two batten lampholders, two fuses and two switches upon a pattrass and fixed upon the wall near the incoming mains.

The lamps are to be connected in series and suitable for the full circuit voltage, the junction from lamp to lamp being efficiently earthed, one switch being used to control each lamp.

In the event of an earth fault its action is as follows: Current leaves the line viâ the earth fault and returns through the earthed mid-point on the test board, thereby making that lamp brightest upon the leg opposite to the fault.

The switches are fitted so that either leg can be tested separately and faults observed if present on both legs.

The chief disadvantage is that wherever the fault be the lamps will show it. This may be rather troublesome if one is not working off of a private supply.

However, if all the circuits be in turn opened for a few seconds the lamps will indicate which one is faulty.

Now for general workshop testing we require a much more elaborate lay-out comprising:

One D.P. switch and fuses
One ammeter.
One voltmeter.
Two test lamps in parallel.
Two test lamps in series, with mid-point earthed.
One liquid motor starter.
One sensitive galvo and shunts.
Variable resistances for galvo
One resistance box.
Battery for galvo.

The galvo and resistances should be mounted upon a separate board, away from the general supply.

The volt and ammeters will be used for general resistance tests, etc., lamps with mid-point earthed for rough earth testing, lamps in parallel for continuity tests.

The galvo will be used to test insulation resistance and for drop-testing armatures.

To find the insulation resistance connect as Fig. 1, in which

x = insulation resistance in ohms.
r = a high resistance of known value.
G = galvo resistance,
B = battery resistance.

With the insulation resistance in circuit and the galvo shunted, obtain a deflection which call d_1, the shunt s being such that we get $1/n$ of the true reading

Now, with the known high resistance in circuit, and the galvo shunt changed to n_2, obtain deflection d_2.

Then the value of the insulation resistance

$$= x = \frac{n_2 d_2}{n_1 d_1}\left(r + \frac{G}{n_2} + B\right) - \left(\frac{G}{n_1} + B\right)$$

but usually G and B are very small, then.

$$x = \frac{n_2 d_2}{n_1 d_1} r.$$

For drop testing we solder two battery leads to segments at opposite sides of the commutator, and with a resistance and ammeter in circuit close the battery switch.

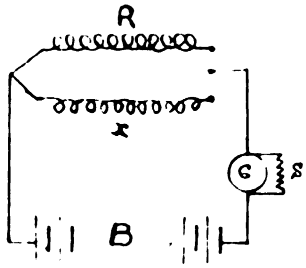


FIG. 1.

The test contacts are placed on adjacent segments and the deflection noted. Adjust the resistance so that the current gives a suitable deflection, and then step round the commutator.

Readings lower than the average indicate short or partial short circuits, while high readings indicate bad connections or a break in the coil under test.

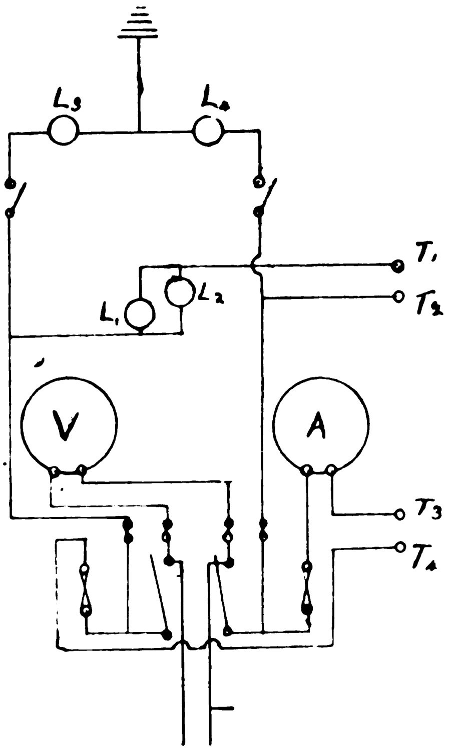


FIG. 2.

The liquid starter mentioned is meant to be used for "running tests" of motors after repair in the workshop. A "liquid" starter can be used over a wide range by varying the density of the electrolyte. The starter may be used as a spare for the whole plant in some cases.

As regards mounting there is little room for comment, since, with the exception of the liquid starter and galvo resistances, the whole of the instruments will be ordered for switchboard mounting.

Fig. 2 gives the connections and illustrates the layout.

Terminals T_1 and T_2 are used in connection with the lamps L_1 and L_2 for continuity tests, etc., while terminals T_3 and T_4 are used for motor and general tests.

The lamps L_3 and L_4 may be left continuously in circuit.

A slate or marble panel is to be preferred in place of a board.—"D. J. WILSON."

No second award is made.

Reviews of Books, &c.

[*Books noticed in this column will be sent from* ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.*]

PITMAN'S RADIO YEAR BOOK, 1924. (Sir Isaac Pitman and Sons, Ltd. 1s. 6d. net.)*—The Year Book for 1923 having been in constant demand during the past year, we welcome the 1924 revision, more especially as it has been enlarged and extended and contains a wealth of useful information and technical data of value. As before, the frontispiece shows a map of the broadcasting stations and the one completed relay station. Circles are drawn with the various broadcasting stations as centres, and these show the areas in which receiving sets of various types are likely to operate satisfactorily.

Contributions to the book have been made by many distinguished radio engineers and scientists, and the retrospect and prospect of the British Broadcasting Company, written by the managing director, Mr. J. C. W. Reith, shows what has been accomplished in the way of broadcasting. Full details relating to post office conditions, royalties, licences, etc., are given.

As a handbook, it contains information which gives it value, such as a list of wireless societies, a list of amateur radio stations, together with other stations of special interest to amateurs, and brief information on interesting personalities in the world of radio.

The range of technical articles is wide, and even wireless wants are outlined for the benefit of wireless inventors. As all these articles are written by experts, purchasers of the book may be sure of obtaining value for their outlay. The publishers are to be complimented on the addition of the amateur station list, as a handbook for amateurs without such a list is of questionable value.

It is sufficient to say that all amateur stations should possess a copy, and the division of the back edge of the book into two distinct colours facilitates its discovery in the bookcase or book pile where it may happen to reside.

The general section provides many items of interest to the non-technical reader, and even in the technical section some very useful information, such as "Crystals and Crystal Detectors," will be found.

---

* Or 1s. 8d. post free from ELECTRICITY Office per return.

For experimenters at a loose end, Mr. Swinburne's article on "A Line of Experiment" will provide much food for thought and action. We compliment the publishers upon the new edition of their book.

Various Items.

L.C.C.—The L.C.C. Education Committee recommend the acceptance of the tender of Messrs. H. J. Cash and Co., Ltd., at £385, for the wiring and lighting of the "Millbank" school.

Calendars.—A handy memo. tablet, with plain paper and outer celluloid covers with calendar thereon, has been issued by the Pirelli-General Cable Works, Ltd., and will be found useful for brief business notes.

New Appointment.—Lieut.-Colonel Norman Harrison, C.M.G., D.S.O., M.I.E.E., who retired last November from the Under-Secretaryship, Department of Posts and Telegraphs of the Union of South Africa, and who, for many years previous, was Engineer-in-Chief, has joined the directorate of the Western Electric Company, Ltd., and will shortly return to South Africa to take up residence there in the interests of the company.

Electricity on the North-East Coast.—We have received from Mr. Andrew Gemmel a pamphlet entitled "The Syndicated Supply of Electricity on the North-East Coast and the Abuse of Statutory Powers," the price of which is 6d. (post free 7d.) from him at 8, Ashfield Terrace, Ryton-on-Tyne. It is really a reprint of a statement made by him at the annual meeting of the Newcastle-on-Tyne E.S. Co., Ltd., on March 27, 1923, with amplifying notes, and is the author's criticism of the way in which that company's accounts are presented to the shareholders, with which, apparently, he does not by any means agree.

Meetings.—A students' meeting of the I.E.E. will be held on Friday, the 25th inst., at 7 p.m., when a paper on "Alternating Current Bridge Measurements" will be read by Mr. A. Serner.——There will be an ordinary meeting of the I.E.E. in the Lecture Theatre of the Institution on Thursday, the 31st inst., at 6 p.m. Paper, "Some Researches on the Safe Uses of Electricity in Coal Mines," by Prof. W. M. Thornton. Also there will be a wireless section meeting on Wednesday, February 6th, at 6 p.m. Paper, "Atmospherics and Their Effect on Wireless Receivers," by E. B. Moullin.——The Scottish centre of the I.E.E. will meet at The Rooms, 207, Bath Street, Glasgow, on Tuesday, February 12, at 7.30 p.m., when Prof. S. Parker Smith will read a paper on "Railway Electrification in Foreign Countries."

Plant Wanted.—The Egyptian Ministry of the Interior invites tenders for electrical installations at:—Benha, adjudication March 20; Miniet el Kamh, adjudication April 3; Beni-Mazar, adjudication April 10; Chebin el Kom, adjudication March 27. The plant required comprises Diesel driven D.C. generators, together with transmission lines. Complete tenders for each station are to be submitted.——The Corporation of Invercargill (New Zealand) invite tenders for the supply and delivery of five 100-kva., eight 50-kva., and eight 30-kva. three-phase transformers. Specifications, etc., at the D.O.T. (Room 52), 35, Old Queen Street, S.W.1.

Trade Notes.

We have received from **Marconi's Wireless Telegraph Co., Ltd.**, their pamphlet, No. 223, which describes and illustrates their multi valve amplifying detectors and low-frequency magnifiers. The apparatus described is for commercial use, and much technical information of interest and use is contained in the pamphlet. General notes on amplification, both high and low frequency, are given, together with information to assist in the selection of the type of set best suited for use under certain known conditions, while a series of curves show the wave-length best covered by certain models and other curves show the results obtained with given types when reaction is used. The illustrations are evidence of the care exercised in the design and lay-out of the various sets described, and afford striking examples of what can be done with the low-capacity type of valve of the V24 type. The capacity clip is an interesting feature that will be new to many. Every individual connected with commercial wireless should obtain a copy of this pamphlet (No. 223), as a careful study of it will show the results that can be obtained with Marconi products

The **Midland Electric Manufacturing Co., Ltd.**, have appointed Mr. G. T. Hickling to be sales representative in South Wales and the South-Western Territories.

A booklet dealing with the Macintosh surface wiring system has just recently been issued by the **Macintosh Cable Co., Ltd.**, of 22/23, Jewin Street, London, E.C.1. It has been carefully prepared so as to be of direct interest to all householders, and it will therefore appeal to electric light and installation contractors throughout the kingdom, who should make a point of having copies in order to give them to their clients when submitting estimates for installation work to be carried out or extensions added. Copies may be obtained by the trade on proper application to the company.

The "Sunco" monthly stock price list has just come to hand. We expect it has also been received by the **Sun Co.'s** trade customers generally. If not, it will be sent on application (trade) to 120, Charing Cross Road, W.C.2.

List 316, issued by **Fuller's United Electric Works, Ltd.**, of Chadwell Heath, describes and illustrates the company's "Sparta" loud-speakers and tone selectors, both of which will appeal to dealers in wireless supplies who wish to push really reliable lines. As such they should be written for.

The usual charming calendar has reached us from the **D.P. Battery Co., Ltd.**, at Bakewell. It is an exquisite specimen of colour printing, and shows the river Derwent near Ambergate, one of the prettiest pieces of the lovely scenery of the Peak district. Needless to say, it will serve as an excellent reminder of the D.P. accumulators and their reputation for quality.

Messrs. Charles Erith and Co., Palace Chambers, Bridge Street, London, S.W.1, have just issued a new 64-page fully illustrated catalogue of the Riley stokers, as applied to water-tube boilers of all makes, including many of the largest unit boilers in the world, and they will be happy to send this catalogue free on request.

Bruce Peebles and Co., Ltd., engineers, Edinburgh, have appointed Sellar, Inglis and Co., of 144, St. Vincent St., as their agents for the West and North of Scotland.

Simplex Conduits, Ltd., announce the following changes in their selling organisation, viz.: Mr. J. McLellan to be sales superintendent of the northern area, and Mr. J. Huntington to be Midland sales superintendent. Under these new arrangements Mr. J. Entwistle becomes manager of the Manchester Branch, Mr. H. D. W. Earnshaw manager of the Newcastle Branch, and Mr. S. G. Orchard manager of the Bristol branch.

MARRYAT & PLACE, ENGINEERS.
28 HATTON GARDEN, E.C.2

Sample Pair Sent on Approval for 8/6

Made of Pure Para Rubber, soft and durable and unaffected by climatic conditions
DAVID MOSELEY & SONS.
Limited.
ARDWICK. MANCHESTER.

MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
A PRACTICAL TRADE JOURNAL

FEBRUARY 1, 1924.

CONTENTS. PAGE

Alternating-Current Bridge Measurements 53
"Broadcasting" 54
Those Old Stagers 54
Research on Illumination 55
The "W.S." Three-phase Motor 55
Some Experiments on the Screening of Radio Receiving Apparatus 56
Some Researches on the Safe Use of Electricity in Coal Mines 56
Current Topics 59
Correspondence 61
Problems in Telephony, Solved and Unsolved 62
Electrification of the French Midi Railway 64
Reviews of Books 65
Questions and Answers by Practical Men 66
Various Items 66

ALTERNATING-CURRENT BRIDGE MEASUREMENTS.*

By A. Serner, B.Sc., Student.

The basic bridge from which others have been developed is the Wheatstone bridge, which, though normally used with continuous current, can also be used with alternating current if the arms are all free from inductance and capacity. If the resistances of two adjacent arms are replaced by reactances of equal phase angle, the bridge can be balanced by adjusting the resistances in the remaining arms. This is the case of the two series bridges—the series-inductance bridge and the Wien bridge—which respectively afford the means of comparing inductance with inductance and capacity with capacity. The Maxwell bridge is derived from the alternating-current Wheatstone bridge by inserting an inductance in series with one arm and a condenser in parallel with the opposite arm. The bridge, which gives a means of comparing inductance with capacity, is balanced by adjusting the constants till the reactive arms have equal and opposite angles and the remaining resistances are proportional. The Anderson bridge is a modification of the Maxwell bridge, the change consisting in the introduction of a resistance in series with the condenser, the detector being connected to the junction between this resistance and the condenser. Another method of comparing inductance with capacity is provided by the Owen bridge, of which one side consists of a resistance arm and an inductive arm, and the other of a condenser only and a condenser and resistance in series. Balance is obtained by making the lagging effect of the inductance in the resistance side equal to that of the resistance in the capacity side. The Carey Foster bridge provides a useful means of comparing capacity with mutual inductance. The drop in the secondary of a mutual inductance is compensated by induction from the primary, the phase being adjusted by means of a condenser in series wth a resistance.

In all the above bridges, balance is independent of frequency, thereby rendering accurate adjustment of the latter unnecessary. The resonance bridge is not independent of frequency and therefore affords a useful means of measuring the latter. It consists of three non-inductive arms and an arm made up of a condenser, an inductance and a balancing resistance. When this arm is adjusted to resonance it, too, is non-inductive and the bridge becomes in effect a Wheatstone bridge.

Conditions of balance.—All alternating-current bridges have two equations to be satisfied as they must be balanced for phase as well as magnitude. There are three methods of deriving these equations, namely, from first principles, from the vector diagram, and by the symbolic method.

First principles.—The bridge is assumed balanced and the current-voltage equations written down. These equations are combined to eliminate all expressions for voltage and all currents except one. The resulting differential equation shows the condition that must be fulfilled.

The vector diagram.—The supply voltage and resulting currents are assumed to be sinusoidal and therefore capable of representation by rotating vectors. Assuming the bridge to be balanced, the vector diagram is drawn and the equations deduced from the geometry of the figure.

The symbolic method.—This is a method of treating the vectors algebraically without actually drawing the diagram, by using $j = \sqrt{-1}$ to represent a right angle. The vector equations are written down and the current terms eliminated between them. Equating the real and imaginary parts of the resulting equation gives the conditions of balance.

Independence of conditions of balance.—As two equations are to be satisfied two adjustments must be made, and for ease in working it is necessary that these must be mutually independent. To find which two constants satisfy this condition, the vector diagram is drawn to scale and the displacement caused by a given variation of each constant in turn is plotted. The constants to vary are then those causing displacements which are mutually at right angles.

Conditions for maximum sensitivity.—There are two aspects of this problem, the bridge itself and the alternating-current detector. The former is studied by means of the vector diagram which shows that the impedances of all four arms should be equal. As regards the detector a vibration galvanometer is more efficient at frequencies up to 300 periods per second and a telephone receiver is better at higher frequencies. It is found that low resistance telephones are better than those of high resistance. This is due to the fact that for a given voltage the power taken and, assuming constant efficiency, the noise emitted are inversely proportional to the impedance. This effect more than compensates for the shunting effect which lowers the voltage across the telephone.

Effect of iron cores.—The inductance and effective resistance of a given iron-cored coil are dependent on the strength and frequency of the measuring current and on the degree of magnetisation of the iron. It is therefore necessary to carry out tests on a coil of this type with a standard current and with the iron thoroughly demagnetised.

---

* Abstract of paper read before the London Students' Section of the I.E.E.

Another effect of iron is the introduction of harmonics even when the supply voltage is sinusoidal. These harmonics render balance difficult as they become prominent when the bridge is being balanced for the fundamental.

Effect of condenser dielectric absorption.—The effect of dielectric absorption is to produce a small current component in phase with the voltage on the condenser, i.e., it acts like a small resistance in series. The equations for any bridge using a condenser must be corrected to allow for this. The value of this equivalent series resistance and also the effective capacity of the condenser vary with frequency, hence it is necessary to know the frequency when making accurate measurements.

General precautions.—High insulation must be used for all leads in order to avoid leakage. Inductance and capacity effects must be minimised by using twisted leads as short as possible. Interference must be avoided by spacing and removal of extraneous metal. Remaining errors are allowed for by taking a zero reading and by employing the method of substitution.

Thanks are due to Messrs. Siemens Bros. and Co., Ltd., for assistance in the preparation of diagrams and slides, and for permission to use their laboratory apparatus for experimental purposes.

"BROADCASTING."

At a meeting of the Informal Section of the I.E.E. on Monday, January 21, Mr. R. Grierson was in the chair, when Mr. E. H. Shaughnessy opened a discussion on broadcasting. The opener was in true informal mood, in turn serious, gay and ironical, but always vastly entertaining and instructive. A packed meeting included many wireless experts and enthusiastic amateurs thirsting for information or to describe their latest achievements, and the debate might have gone on till very late, but that the chairman closed the discussion in view of the difficulty of getting home.

Mr. Shaughnessy claimed that the policy adopted by the British authorities for the control of broadcasting had been thoroughly justified. It had aimed at putting broadcasting on a self-supporting basis, but the calculations had considerably under-estimated the tremendous growth of licensed receivers and the developments had been much more extensive than were deemed possible. The British Broadcasting Co.'s monopoly by its freedom from financial and patent infringement worries had put British broadcasting far ahead of the rest of the world. Notable consequences also were the familiar use of the valve, the improvement of loud-speaking devices, and the development of the microphone.

Messrs. E. G. Bedford, G. R. Bedford, J. Coxon, W. Day, R. Grierson, W. H. Lawes, H. J. Neill, C. F. Phillips, E. S. Ritter, P. Voigt and W. E. Warrilow contributed to the discussion, which Mr. Shaughnessy reviewed and closed

Meetings.—The Junior Inst. of Engineers will meet on Friday, the 1st inst. Lecturette, "Torsion Meters," by J. Ward (exhibits). Also on Friday, the 8th inst. Lecturette, "Some Physiological Aspects of Heating and Ventilation," by K. Gray, F.S.I. Both at 39, Victoria St., at 7.30 p.m.

THOSE OLD STAGERS.

The second biennial dinner and reunion of the Municipal Electrical Old Stagers was held at the Hotel Cecil on Thursday, the 17th ult., and fifty-one attended, including five guests, who comprised Mr. H. Booth, Electricity Commissioner; Mr. S. E. Britton, President of the I.M.E.A.; Dr. S. Z. de Ferranti; Sir Harry Haward, Electricity Commissioner; and Mr. S. L. Pearce, C.B.E. The chair was occupied by Mr. C. H. Wordingham, C.B.E., who was President of the M.E.A. at the Manchester Convention in 1897, and much interest was shown in the menu card, with the "past" and "present" illustrations, which Mr. Hughman had very kindly had made for the occasion. One showed the original 100 and 240 kw. belt-driven sets at Dickinson Street Station (Manchester), and the other the 35,000 kw. sets at Barton, which have just been erected. Also ample space was left for the autographs of those present, and on the top of one of the pages reserved for this purpose was a cameo of the chairman in high relief. This was of considerable interest, since it was the first instance of the application of what may truly be called a new art to this purpose. The die was made by a new process invented by the son of one of the earliest pioneers in the electrical industry, Mr. Henry Edmunds. By photographic means, a plaster medallion in any desired height of relief is made, and from this a bronze one. This is then reduced in an ordinary copying machine to a size suitable for the required die. This invention is not yet on the market, and those present greatly appreciated Mr. Edmunds' kindness in providing the die.

There was only one toast in addition to the loyal ones, namely, "The Municipal Electrical Old Stagers," which was proposed by Dr. S. Z. de Ferranti with his usual originality and felicity. The speech, which was of an unusually intimate character, was highly appreciated by all who heard it. It was duly responded to by the chairman, who briefly recalled the proceedings of the first Convention and referred to the views at that time of some of the Old Stagers present. He concluded by a brief account of the process by which the cameo referred to above was made.

Mr. H. Faraday Proctor also responded, and at the same time informally proposed the health of the chairman, who has also acted as hon. secretary of the reunion.

At the conclusion of the dinner, a flashlight photograph of a group of those present was taken, without the usual accompaniment of bottles, tablecloths and debris. The poison gas arising from the flashlight was left behind in the dining-room, and all adjourned to another room, where the rest of the evening was spent in pleasant chats among old friends. There was provided a small and very interesting collection of photographs of early stations and other historical objects, as well as a sprinkling of antique switches, lamp-holders, etc., all of which were contributed by Old Stagers.

The usual features of a reunion, so ably depicted by Fougasse in a recent issue of *Punch*, were avoided, and the enjoyment of all was greatly enhanced by the deliberate omission of all attempt to amuse them officially.

RESEARCH ON ILLUMINATION.

At the meeting of the Illuminating Engineering Society on January 22 there was, in spite of the inclement weather and the railway strike, an enthusiastic audience to hear Mr. J. S. Dow's paper on the above subject.

Mr. D. R. Wilson, who presided, referred to the many opportunities for research as a basis for recommendations on factory lighting, and he and Mr. Gaster emphasised the need for joint effort. This, in fact, was the keynote of the paper. Mr. Dow mentioned many matters, some scientific, others technical, which could be dealt with by individual effort, and quoted instances of useful work in the field of photometry undertaken on these lines. But generally speaking, the scientific treatment of lighting problems demands the aid of many experts. In many cases of research affecting large sections of the community we must also take the views of the user into account. Hence the wisdom of working with representatives of joint industrial councils in making recommendations on lighting conditions for industrial processes. The aid of the architect must also be sought, and the very valuable work that has been done on planning access of daylight into buildings is a good instance of a field where he and the photometric expert should work together.

Much of the paper was concerned with *measurement* of light, and it was pointed out that in illumination, as in all arts, real progress only begins when we have learned to measure the things with which we deal. Illumination photometers are now very much simpler and more convenient than in the past. In the discussion Lt.-Col. K. Edgcumbe mentioned some instances of recent improvements in this field. But, for the benefit of non-technical users, we may hope that the time is not far distant when the ideal of a photometer which will simply register illumination on a dial when pointed towards the source of light may be realised!

Mr. Dow estimated that, according to recent investigations, an ideal source, giving white light but no invisible radiation, might yield as much as 25 candles per watt. There is thus much room for improvement. Possibly, he suggested, the next advance may come through the use of luminescence of gases. It is also probable that in future more attention may be devoted to colour than in the past, and we have much to learn regarding the effects of coloured light on the eye, the mind and the body.

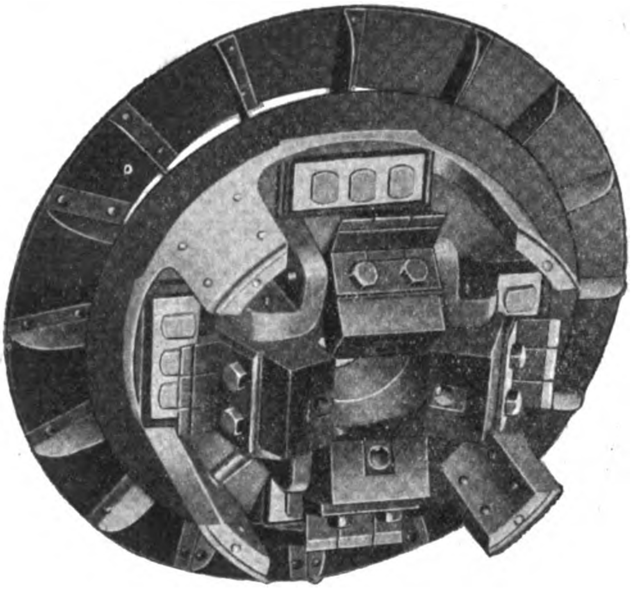
One form of research which demands very careful joint action is the preparation of statistics. Data showing the consumption of energy for street lighting per head of population for various cities, the relation between lighting conditions and accidents, and output and quality of work, should prove extremely valuable to firms concerned with lighting. But the method of preparing such information needs care and the co-operation of statisticians is desirable.

In conclusion Mr. Dow optimistically asserted that there was nothing in the way of research being done in other countries that could not equally well be done in England if adequate support was forthcoming, and it is to be hoped that bodies identified with the lighting industry will give the Illuminating Engineering Society every opportunity of proving this to be true.

THE "W.S." THREE-PHASE MOTOR.

The "W.S." motor, now being marketed in this country, is made in sizes up to 100 h.p. It is of the three-phase induction type, and may be started like a squirrel-cage motor by simply closing an ordinary switch. Owing to the special design, the makers claim that it combines the good features of the squirrel-cage and slip-ring types, viz., simplicity in design and handling and low price, with high starting torque and a greatly reduced starting current.

The motor starts as an induction motor with short-circuited (wire-wound) rotor on an auxiliary winding (starting winding) of comparatively high resistance, the torque developed amounting to 1.5 times the full load torque, while the starting current is less than 1.75 times the full load value.



As soon as the motor has assumed a certain speed at which the torque—which, owing to the increasing slip, is dropping—approaches the full load value, a section of a second three-phase rotor winding (running winding) is put into circuit by means of the centrifugal starting attachment arranged on the shaft of the motor, as shown in the illustration, an additional torque being produced in this manner by which the speed is further increased.

This process is repeated several times until all sections of the second winding are put into circuit, when the motor will behave exactly like a slip-ring motor with short-circuited slip-rings, except that it will not be endangered by the pressure failing for some time.

In cases of this description the centrifugal attachment will automatically open the sections of the running winding. On the pressure returning the motor simply starts again, the fuses remaining intact, as the starting current will keep below 1.75 times the rated full-load value.

In the "W.S." motor there is no manipulation by hand at all beyond closing the switch. Every movement is mechanically operated and automatic, and all starters, resistances, slip-rings, brushes, brush-lifting and short-circuiting attachments—which mean possible failure and certain wear—are dispensed with.

The centrifugal attachment is totally enclosed, so that it is not only protected from dust, but makes the motor suitable for erection in rooms containing inflammable matter, every fire risk through sparks being eliminated.

No series resistances being employed, the rotor current is not uselessly transformed into heat. On the contrary, during the whole of the starting period it is utilised to the fullest extent as active sections of the running winding are automatically put into circuit by means of the centrifugal attachment. The result is that torque as well as efficiency are considerably improved.

As mentioned before, the "W.S." rotor is started by simply closing a triple-pole switch. If the motor is to be stopped, all that is required is to open the switch. Hence, no mistakes whatever are possible, and the motor, being absolutely foolproof, may be handled by anyone.

Starters, slip-rings, brushes, etc., have been eliminated, and as a result the price of the motor is low; there are no parts subject to wear, so that expenses for erection and maintenance will be greatly reduced, while, barring accidents, there is no occasion for repairs.

The motor is fitted with high-grade ball bearings, and the sole agents in this country are Messrs. Brittain and Ferguson, Floor A, Milburn House, Newcastle-on-Tyne.

SOME EXPERIMENTS ON THE SCREENING OF RADIO RECEIVING APPARATUS.*

By R. H. BARFIELD, M.Sc., STUDENT.

The chief object of the investigation was to obtain quantitative information on the effect of screens, of which the dimensions are small compared with the wave-length of the waves they are intended to screen. Some preliminary experiments are described, in the first of which the screening effect of a totally closed iron tank was investigated by an operator inside it with a frame coil receiver; and in the second an investigation was made on the effect of screening a square frame receiving coil by totally enclosing each of its four sides in a metallic envelope. A description is then given of the method employed in subsequent experiments of measuring the effect of screens based upon the employment of two receiving coils connected in opposition. This is followed by an account of measurements made by this method on some specially constructed screens of straight wires, open and closed loops, and wire-netting, etc. These measurements demonstrate the important part played by closed circuits in screening the magnetic field of radio waves, and show that an effective screen may be constructed of wire-netting. In this connection a description is given of the screening of the interior of a hut with this material to protect direction-finding apparatus within it from "direct pick-up."

Further experiments, in which the effect of screens on the electric field of the waves is measured, are then described. Three types of screen investigated were shown to reduce substantially the electric field without affecting the magnetic field, while, later in the paper, it is shown that a fourth type will screen the magnetic field but not the electric field. A cage of the former type is then described which is now in practical use as a means of eliminating "antenna" effect from a single-coil direction-finder contained within it.

A discussion of the experiments follows, some explanation of the various effects being given, and conclusions are drawn as to the general principles of screening and as to the essential points to be attended to in the design of efficient screens for various purposes.

SOME RESEARCHES ON THE SAFE USE OF ELECTRICITY IN COAL MINES.*

BY PROF. W. M. THORNTON, O.B.E.

Space does not permit us to reprint this most interesting paper at length at the present time, although it is possible we may do so later in the season, because it is certain to appeal to all our readers who are engaged in colliery installation work, but in a brief summary we can say that the limiting electrical conditions under which ignition of coal-dust and firedamp may occur have been worked at in the author's laboratory for the past fourteen years as part of a general investigation of the mechanism of ignition of gases. The paper contains an account of some results of practical interest, and deals with the electrical ignition of coal-dust alone, coal-dust with gas present, of methane and associated gases by disruptive sparks, steady or impulsive, transient arcs (either D.C. or A.C.), with varied voltage and frequency, in all percentages of mixture with air. Examples are given of the application of the results to promote safety in mines, notably the influence of currents of higher frequency than usual, of safety bells, safety lamps which give an alarm signal when dangerous mixtures of gas occur, electric lamps which are extinguished by a small change of vacuum due to a cracked glass, and an improved earthing plate.

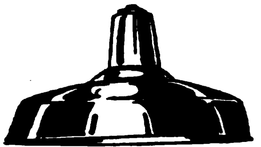
Tenders Accepted.—The Port of London Authority have accepted the tender of the General Electric Co., Ltd., for the supply of gasfilled lamps for the three months ending March 31, 1924.——The General Electric Co., Ltd., have recently received a portion of a contract for the supply of gasfilled lamps to the Midland Railway during the period January 1 to June 30, 1924.

Meetings.—The next meeting of the Diesel Engine Users' Assoc. is to be held on Friday, 15th inst., at the Engineers' Club, Coventry Street, W., to discuss the Committee's second report on "Heavy Oil Engine Working Costs." Non-members interested in the subject and desirous of attending the meeting can make application for tickets of admission to Mr. Percy Still, hon. sec., at 19, Cadogan Gardens, S.W.3.——The Western Centre of the I.E.E. will meet at the Merchant Venturers' Technical College, Bristol, at 6 p.m. on Monday, Feb. 4. Lecture by David Brownlee, Esq., B.Sc., on "Pulverised Fuel and Efficient Steam Generation."——The Inst. of Welding Engineers will meet at the Inst. of Marine Engineers, 85-8, The Minories, Tower Hill, London, on Tuesday, 12th inst., at 7 p.m. Paper: "Some Chemical Aspects of Welding." by J. R. Booer, Esq., B.Sc., F.G.S.

---

* Summary of paper read before the I.E.E.

* Paper read before the I.E.E.



Don't worry! THERE IS A
BENJAMIN
REFLECTOR
for
EVERY CLASS of
LIGHTING
INSTALLATION.

Advert. of the Benjamin Electric Ltd., Brantwood Works, Tariff Road, N.7.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and Abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Tuesday morning, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

The Strike.

Although at the time of writing a railway stoppage has been in operation for a week there is so far very little evidence of any resultant dislocation. The diminution in the transport of coal must inevitably be reflected in all industries; but so far as present records go to show, the railway dispute will have to continue for some time before it has any serious effect upon electricity and power supply. London gas and electricity supply authorities report ample stocks on hand, and as most of their fuel is seaborne, delivered on the wharves, there is no immediate cause for worry. Householders, on the other hand, are being rationed as to their supplies of household fuel, and this is where the electrically-equipped residence will score over its less fortunate neighbour. So long as a fuel supply is available for the main power stations those Londoners who have been farsighted enough to instal electric heating and cooking appliances can ignore the railway strike in so far as it affects their bodily needs and comfort.

Moreover, with heat and light generated and distributed from a central source there is less distribution trouble to face. The railways play a considerable part in the local distribution of coal in and around London, all the coal yards being fed by sidings from the nearest railway line. Consequently, if no mineral trains are running, available stocks must very soon be exhausted. In these times of periodical labour hold-ups it is a point worth bearing in mind as a telling argument in favour of electric light, heat, and power. Meanwhile, road transport interests are having the time of their lives, and reaping a rich harvest by carrying essential goods by road motor from point to point. Trade goes on much as usual, and the industrial centres have organised a road delivery service to tide them over the strike period, lorries going out from works fully loaded with manufactured goods for various destinations, and returning equally loaded with raw materials urgently required.

Good Lighting.

As a sequel to my recent comments on inadequate street lighting, it is interesting to note that experiments which have been conducted at various interchange stations on the London tube system have shown that where the quality of the illumination has been improved passengers move about more briskly, and there is consequent less congestion. Applying this principle to many of our poorly-lit thoroughfares, it is self-evident that similar treatment would prove of material assistance in relieving the congestion on certain pavements after sunset. When such pavements are inadequately lighted there is an unconscious slowing up on the part of pedestrians who, not sure of their ground, walk more warily and consequently more slowly than when full daylight is available. The moral is obvious, and should not be lost on the newly-constituted Association of Public Lighting Superintendents.

There is another point in favour of better lighting, and that is on financial grounds. It has been definitely proved that good modern scientific illumination is actually cheaper than the obsolete forms of artificial illumination to which some people mistakenly cling on the score of economy. As an example, the Caistor Guardians recently decided to advertise for tenders for a system of electric lighting at the workhouse. Mr. J. Thornton stated that from a statement issued he found that out of twenty-four Unions in the North Midlands their workhouse was at the top as regarded expenditure on lighting, their obsolete method, by paraffin lamps, costing two shillings per head.

Broadcasting.

Is it merely coincidence, or do "spark" stations regularly carry out Morse practice with friends at sea and off our coasts at times coincident with the broadcasting of late new and certain musical programmes? I had an experience the other night listening to Birmingham Broadcasting programme at a seaport town which has the misfortune to boast one of these Government transmitting stations, and as a result can sympathise with resident broadcast listeners in the vicinity of this or any other similar land station. The accompaniment started with the announcement of the first news bulletin, and continued without intermission until 2LO had finished. Then commenced what would have been a vastly entertaining programme, comprising a well-thought-out pantomime set to broadcast.

No sooner had the announcer declared the show open, than our friend at the near-by Morse also found it convenient to recommence his solo, only ceasing for a minute or two each time there was an interval in the broadcasting, and taking up the chorus again directly Birmingham announced another act as about to begin. From start to finish I should think that operator must have sent out about three full pages of the *Daily Mail* to his various correspondents, and it utterly ruined the actual broadcasting, because it is next door to impossible to tune out these raucous spark signals, resembling the filing of an empty tin, when they are located so closely to one's receiving set. Whilst appreciating the indispensability of spark stations and the invaluable services they perform, I think it is up to the Broadcasting authorities to find a speedy remedy for the present difficulty experienced by all their patrons who have the misfortune to reside in the very considerable areas of influence of these ether penetrating installations.

Electric Lifts.

A rather interesting and probably little-known fact emerged in the course of a recent lecture by Mr. H. Marryat at the Institution on Electric Passenger Lifts. Due to the comparatively limited heights of buildings in British cities and towns electric lifts are not subject to such attention and development in this country as they are in the States, where, due to the vogue of the "skyscraper," the lift is so important a factor in the daily life of Americans in the larger cities that it has been computed that the total daily mileage of lifts in America is greater than that of the combined tube and tram services. This is a fact which affords interesting food for reflection. It means that the average dweller in the larger American cities spends more time travelling up and down in the world than he does in passing from point to point on the surface or below ground. As a natural consequence the development of the electric lift in America has progressed apace, but not on lines necessarily well adapted for British requirements.

Turkey Needs Automatic 'Phones.

According to Rafet Pasha, speaking in the Angora Assembly, there is a "black room" at the Constantinople telephone exchange which controls all conversations. In other words, there is no guarantee of secrecy in connection with the public telephone service of that city, and a system of telephone espionage exists where no doubt the telephone conversations of well-known politicians and public characters can be overheard whenever it is considered desirable. In the name of liberty Rafet Pasha demanded the suppression of this telephone espionage. It is fairly evident that what Constantinople telephone subscribers want is an up-to-date automatic telephone installation, which has no operators to act as political spies and report the gist of certain conversations to heads of the Government. An outstanding advantage of the automatic system is its secrecy.

The Kelvin Centenary.

Lord Kelvin was born on June 26, 1824, and it will, I am certain, interest my readers to know that arrangements are being made by a committee convened by the Royal Society to celebrate the centenary of his birth in fitting manner. Sir Richard Glazebrook, K.C.B., F.R.S., is to be chairman, and it will also include Dr. Alexander Russell, President I.E.E., Sir Charles Morgan, of the Inst.C.E., and many other representatives of the learned and scientific societies, with Mr. D. N. Dunlop as Hon. Sec. Quite a large number of Dominion, American and foreign men of science and engineering will be attending conferences at the British Empire Exhibition at that time, and July 10 and 11 have therefore been selected as convenient dates for the Kelvin Celebrations.

These will include a meeting for the receipt of addresses from delegates, at which Sir J. J. Thomson will deliver a Memorial Oration, and a dinner at which the Rt. Hon. Earl Balfour has kindly promised to preside. There will also be an exhibition of Kelvin apparatus, and it is hoped to issue a Memorial Volume containing the addresses and speeches delivered, with some account of the apparatus exhibited.

E.T.B.I.

In a recent issue of this paper I referred to the 1923 Festival of the Electrical Trades Benevolent Institution which was held under the chairmanship of Sir Philip Nash, and I mentioned in my notes that the sum of approximately £1,250 had been collected or promised. I have just heard from Mr. F. B. O. Hawes that certain other amounts have since been received making a grand total of £1,389 8s. 6d., on which I congratulate him most heartily, but I stick to my grumble all the same. Like Oliver Twist of immortal memory, the E.T.B.I. still wants more support from the rank and file of the industry, and we must do our d——est to see that it gets it. I expect Mr. Fletcher will forgive the forcible way in which I make this appeal, and I am equally confident that Mr. Hawes will be delighted to send along particulars of membership and the benefits thereof to all those who will write him at 18, Park Mansions, South Lambeth Road, London, S.W.8, and ask for the said information. So don't put it off, but just do it. I am not a pessimist, but you never know your luck.

The C.T.S. Competition.

I am writing these lines just before the home closing date for this interesting competition, for which the papers are coming in steadily, and I expect the 31st will bring in a regular budget, but I want to maintain the interest of my Colonial readers who have until March 31st to send in their replies, and I hope they also will make a respectable show, because their experiences in hot and cold, and, in fact, in all sorts of climates, are certain to prove of value to the company's clients.

ELEKTRON.

World Power Conference.—We have received from the Organising Director of this Conference, at 36, Kingsway, London, W.C.2, a copy of a preliminary announcement regarding the conditions and privileges of membership. These should be of interest to a very large number of engineering readers, and it is to be hoped that the Conference will be most enthusiastically supported, so as to make it the success which it well deserves, more particularly in view of the fact that it is nearly certain to be of direct value to the trade of this country.

An Interesting Announcement.—Two lectures will be given to the members of the Women's Engineering Society at the Samson Clark Lecture Hall, 57, Mortimer Street, W.1 (three minutes from Oxford Circus), at 6.30 p.m., followed by a discussion. They are:—February 5: Lecturer, Miss M. Partridge, B.Sc.; subject, "Electricity as Used for Publicity"; and March 4: Lecturer, Miss M. E. Phillips; subject, "Factory Legislation (Past, Present and Future)." All men and women interested in the above subjects are invited to attend. Tickets on application to the Secretary, W.E.S., 26, George Street, W.1.

Correspondence.

KERB LIGHTING.

To the Editor of ELECTRICITY.

DEAR "ELECTRON,"—I was interested in your remarks in the current number of ELECTRICITY on the subject of kerb lighting of pavements. Owing to a recent removal, I have not read your preceding remarks on the subject, and the numbers containing them are still packed up, so that I may be repeating what has already been said by other correspondents. The scheme has already been tried, I believe, in the land of new ideas, the U.S.A. I remember reading about the scheme, and studying illustrations of the methods proposed—if not actually installed—some years ago, in, I believe, the *Electrical Review*. From the fact that no more has been said about it, one would gather that the scheme was not a success. I think that it would be unsuitable for three reasons :—

(1) Though it would be possible to protect the pedestrian from the direct glare of the lamps by tucking them under a canopy on the kerb, it would not be possible to protect him from reflected glare from the surface of a smooth macadam road in wet weather, and he would be in somewhat the same position as a traveller facing the rising or setting sun in flat country.

(2) The low lighting would have to be supplemented by other lighting higher up, or one would not see one's fellow-man on the road, and collisions would be frequent.

(3) The irregularities of uneven roads such as you mention would be emphasised, and would be very disconcerting to the stranger. *A propos* this last, I am reminded of the account of a night hunt of rabbits with the help of bicycle acetylene lamps. The account of the sport was contained in that now defunct weekly, the *Modern Man*.

The method was to get up close to the browsing rabbits on a moonless night, unmask the lamps, mark a rabbit, and pursue it on foot until close enough to knock it down with a stick. The explanation of the success of the method was that the powerful glare of the lamps cast excessive shadows, and the rabbit leaped unnecessarily high to clear the obstructions, and so enabled the man to gain on it.

Yours truly,
B. PLATT.

10, Victory Road, Wendover, Bucks,
January 21, 1924.

"QUESTIONS AND ANSWERS."

To the Editor of ELECTRICITY.

SIR,—In your answer to Q. 169, published in the January 18 issue, your contributor " D. J. Wilson " makes a serious error on line 2, col. 1, p. 36, when he states that drop in volts in the resistance $=C^2R$.

This expression gives the loss in watts, and the expression for the voltage drop is RI (or, using the obsolete symbol C for current, is CR).

Consequently the resistance required is 15 times the value obtained, and the length of wire needed would be, not 21 yards, but nearly 315 yards (actually 312 yards).

Your contributor has tackled the matter so ably in other respects that I feel sure that this is only a slip, though the small amount of wire obtained by his calculation ought to have aroused his suspicions that something had gone wrong.

I think the winner of the first prize put his finger on an essential consideration when he pointed out the waste of power which the method introduces, but that, of course, is the concern of the man who proposed trying the scheme. It was, nevertheless, a vital point to bring to his notice, since he is apparently unfamiliar with the financial aspect of the apparatus.

I looked for a description of a water resistance, since that would meet the case admirably if a temporary apparatus was wanted—and such a wasteful method would surely only be temporary—and designs of such a nature could be varied from a lead plate in a bucket containing a solution of washing soda, to more elaborate apparatus consisting of sectors of lead plate on a spindle with fine adjustment control.

I may say I thoroughly enjoy this feature of your admirable paper, and look forward with interest to the questions asked and their subsequent solutions.

Yours sincerely,
B. PLATT.

10, Victory Road, Wendover, Bucks,
January 21, 1924.

[NOTE.—Our Competition Editor noticed the error referred to, but realised it was, as Mr. Platt suggests, a slip. It was because the effort was considered so good that an additional prize of 5s. was awarded. It is our policy in this competition to place the winning replies before our readers exactly as they are received—that is, without alteration to the wording of the text. At times, however, it is necessary to re-draw some of the sketches to make them suitable for our columns. We invite all our readers to take part in this competition, since we feel sure that, in obtaining the benefit of each other's experience, a great deal of good will be done.—EDITOR ELECTRICITY.]

TRADE IN RUSSIA.

To the Editor of ELECTRICITY.

SIR,—Legislation permitting the patenting of inventions in Russia under the new regime is now in a fair way to being consummated, and the registration of trade marks may, it is hoped, after reciprocal treaties have been concluded, follow subsequently.

British patentees and manufacturers are advised to be early in the field to secure priority and thus protect their rights against infringement. The possession of a patent or trade mark is not only a valuable asset to a business goodwill, but early protection is a necessary forerunner to the opening up of trade relations and the safeguarding of industrial rights therein.

We shall be pleased to furnish further particulars on application.

Yours truly,
KING'S PATENT AGENCY, LIMITED,
146a, Queen Victoria Street, London, E.C.4.

Social.—We congratulate the staff of the Siemens and English Electric Lamp Co., Ltd., on the excellent way in which they arrange their social entertainments. Most certainly there is an ample fund of wit and humour readily available, and we are therefore not surprised to hear that the staff concert and social which was held at 38/39, Upper Thames Street, E.C.4, on January 25 last was an unqualified success, and it must have given Mr. S. Callow, the general manager, much pleasure to preside at such a well-managed function.

PROBLEMS IN TELEPHONY, SOLVED AND UNSOLVED.*

By PROFESSOR J. A. FLEMING, M.A., D.Sc., F.R.S.

(*Continued from page* 48.)

Another type of thermal receiver of some promise is that due to Mr. Leslie Miller, which he calls a loose-contact thermal receiver.† In this receiver two pieces of certain substances are employed, one in the form of a small disc attached to the back of an aluminium diaphragm, and the other in the form of a ball, or point just slightly pressed in contact with the disc. The substances may be galena and carbon (graphite), or both carbon. A small direct current is passed across the contact and, when a telephonic speech current is superimposed, the diaphragm reproduces acoustically the speech. The action may be due to a slight separation between the contact points due to the repulsion between the elements of a conductor conveying a direct electric current, and this is increased or diminished when the alternating speech current is superimposed, thus causing the diaphragm to vibrate. This principle of a loose microphonic contact as a speech reproducer is well worth continued investigation. We have then in the next place the electrostatic receiver which in a certain form was originally suggested by Dolbear and by Edison, but in its most perfect form is the condenser transmitter and receiver already described.

Lastly, we may mention the variable-friction principle which was employed by Edison in the quite early days of telephony in his chalk cylinder receiver.

In this instrument a cylinder of chalk, which Edison found it best to moisten with a solution of hydrodisodic phosphate, is slowly revolved. On it rests a light metal bar in connection with a mica diaphragm. When the cylinder revolves the slight friction displaces the bar and cups in the diaphragm, but when a telephonic current passes from the metal to the chalk the friction is reduced and the bar slips and communicates its motion to the diaphragm. Sir William Barrett investigated the effect in 1879 and 1880‡ and stated that he found that if the chalk was dry there was an increase of friction. Mr. Rollo Appleyard described in 1905 the adhesion of a metal plate to a dielectric when a difference of potential is made between them.

This fact was rediscovered and applied in the construction of a telephone receiver by Messrs. K. Rahbek and A. Johnsen using an agate cylinder and a metal contact block, as described in a lecture given before this Institution on May 26, 1921. The most general statement that can be made is that when two substances, one or both of which may be a metal, or in a few cases both non-metals, are in contact with each other, the sliding friction is either reduced or increased by the creation of a difference of potential between them.

The whole phenomena has during the last two years been very carefully re-examined in the electrical research laboratory at University College, London, by Mr. H. M. Barlow, and the results of his work will before long be made known. In all these methods there are possibilities of constructing a telephone receiver which may perhaps be found to have greater acoustic efficiency than the present types of Bell receiver.

An electrodynamic receiver which seems to have great possibilites in the way of improved efficiency has been invented by M. L. Gaumont, who exhibited it recently to the Academy of Sciences at Paris. The vibrating part of the instrument consists of a little cone of silk wound with a spiral of aluminium wire, through which the telephonic currents flow. This is fixed between the poles of an electromagnet or of a powerful permanent magnet, the poles of which are bored out with holes to permit the air waves, which are produced when the coil vibrates in the magnetic field, to pass. This receiver is said to emit a very loud and clear sound.

The energy-transforming efficiency of the microphone transmitter has not been made the subject of so much experimental investigation as that of the Bell receiver.

In the ordinary microphone transmitter with associated induction coil we supply power in two forms, (i) in the form of direct current, and (ii) in the form of aerial speech wave power which vibrates the diaphragm and modulates the direct current. We have therefore joulean losses in the carbon granules and in the induction coil circuits, as well as magnetic energy losses in the latter, and, in addition, work is spent in the deflection of the diaphragm and in creating eddy currents in the air near it. Owing to the necessity for supplying the direct-current power, the actual proportion of the whole power applied which makes its appearance as electric speech current-power in the line must be small, but I have not been able to obtain actually measured results.

To overcome the difficulties connected with the low resonance frequency of the ordinary carbon microphone diaphragm, there has been a certain use of the condenser transmitter with a very tightly strained and therefore more aperiodic diaphragm for certain purposes such as wireless telephone broadcasting. Also improved forms of magneto telephone with thick diaphragms which have a natural frequency above the ordinary speech range have been employed very successfully for the same purpose in Great Britain. It would, however, be very advantageous to get rid entirely of the necessity for a diaphragm. It is well known that the carbon electric arc can be used as a speech transmitter. Hence the new glow discharge microphone of Dr. Phillips Thomas of the Westinghouse Electric Company of America, in which the speech air waves directly modulate an electric discharge current, is a distinct advance and is said to have been used for some time with marked success as a broadcasting transmitter in the United States.

VI.—THE TRANSMISSION PROBLEMS OF THE TELEPHONE LINE.

(12) When we turn from the consideration of the telephone transmitter and receiver to that of the telephone line we find a number of interesting problems to which a fairly satisfactory solution has been given of late years. In the young days of telephony it was not at all clearly understood that the inductance of the line plays a more important part in telephony than it does, or at least did, in submarine cable telegraphy.

---

* Lecture delivered before the Institution of Electrical Engineers, to whom we are indebted for the illustrations.

† See *Journal of the Wireless Society of London*, 1921, vol. 2, 141.

‡ See *Nature*, 18th March, 1880.

BRITISH PRODUCTS.

The British Empire EXHIBITION

is planned to show the world the specialised products of the Empire.

ELECTRIC CABLES

are an essentially British Product. Their world-wide acknowledged superiority is the achievement of the

C.M.A.

Regd. Trade Mark 422219-20-21.

who have organised a combined exhibit of its members.

Copyright L. B. Atkinson, Exclusive Licensees, Members of the C.M.A.

Members of the Cable Makers' Association :—

The Anchor Cable Co., Ltd.
British Insulated and Helsby Cables, Ltd.
Callender's Cable and Construction Co., Ltd.
The Craigpark Electric Cable Co., Ltd.
The Enfield Cable Works, Ltd.
The Greengate & Irwell Rubber Co., Ltd.
W. T. Glover & Co., Ltd.
W. T. Henley's Telegraph Works Co., Ltd.
The India-Rubber, Gutta-Percha & Telegraph Works Co., Ltd.
Johnson & Phillips, Ltd.
Liverpool Electric Cable Co., Ltd.
The London Electric Wire Co. and Smiths, Ltd.
Pirelli-General Cable Works Ltd.
Siemens Brothers & Co. Ltd.
St. Helens Cable & Rubber Co., Ltd.
Union Cable Co., Ltd.
Western Electric Co., Ltd.

Advertisement of the Cable Makers' Association, Sardinia House, Sardinia Street, London, W.C.2.

Hence the early telephonists applied the theory worked out by Lord Kelvin for the submarine cable transmitting relatively low-frequency currents to the telephone cable transmitting high-frequency currents, with the result that erroneous ideas became prevalent.

We owe to Mr. Oliver Heaviside, as is now everywhere acknowledged, the enunciation of the true theory of the telephone line and an explanation in 1887 of the causes of, and best remedy for, the distortion of the wave-form of the speech currents it produces. The various harmonic currents into which the complicated electric speech waves can be resolved travel at different speeds along the cable and attenuate at different rates. The short waves travel faster and attenuate more rapidly than the longer electric waves. Hence a distortion of the wave-form results, and beyond a certain length of line the reproduced articulate sound becomes unrecognisable by the ear. Heaviside gave the statement of the conditions which must be fulfilled by a distortionless cable, and insisted on the necessity for increasing its inductance to approximate to this condition in the case of existing lines.

The late Professor S. P. Thompson in 1891 and 1893 described in British Patent Specifications various remedies for distortion, and in 1893 read a paper at Chicago on "Ocean Telephony," which drew much attention to the subject. In his Presidential Address to this Institution in 1899 he strongly urged a practical trial of his suggestions.

As a long telephone cable is a somewhat expensive article, practical telephonists were obliged to advance slowly. The introduction of the dry-core or dry loose-paper insulation in a lead sheath, in or about the year 1887, aided in the reduction of cable capacity and was therefore a step in the right direction.

The important papers published in 1899 and 1900 by M. I. Pupin brought within the scope of practical achievement the scientific recommendations of Heaviside as to the increase of inductance of the line. Pupin showed theoretically and practically that a telephone line can have its inductance increased so as to approximate to the Heaviside condition for non-distortion by the insertion of special inductance coils at equispaced intervals. If these intervals are not much greater than one-tenth of the wave-length of the electric wave travelling on the so-loaded cable, the coils act as if their inductance was uniformly distributed along the line.

If the impedance per unit length of the line changes suddenly at any point to a higher or lower value, then a wave of electric current travelling along the line suffers partial reflection and partial transmission at that junction exactly as a ray of light is partly reflected and partly transmitted at the bounding surface of two transparent media of different refractive index, provided that the change in refractive index is very sudden. In short, the quantity we call the characteristic impedence of a telephone line, which in complex expression is $\sqrt{(R+jwL)}/\sqrt{(S+jwC)}$, where R, L, S and C are the resistance, inductance, leakance and capacity of the line per mile or naut, is exactly analogous to the quantity called the refractive index in the case of light propagation.

If, then, a telephone line has an inductance coil inserted at some point, there is a partial reflection of the electric waves travelling along the line at that point. If coils are spaced apart at distances large compared with the wave-length the repeated reflections would render the line non-transmissive. If, however, the coils are at intervals short compared with the wave-length, then they are equivalent to a uniform distribution of added inductance along the line and diminish its attenuation.

A quantity of fundamental importance in the case of a telephone line is its *attenuation length* or the product of its attenuation constant and its length in miles. The attenuation constant may be defined as the reciprocal of the length of the line in which the current or voltage falls in the ratio of 2.71828 to 1 or to 36.7 per cent. of its initial value, or by 1 napier. Telephonists express the attenuating qualities of any line in terms of those of a certain standard cable consisting of a copper core weighing 20 lb. to the mile, one mile of double core, lead and return, having a resistance of 88 ohms, an inductance of 1 millihenry, and a line-to-line capacity of 0.05 microfarad. This standard cable has an attenuation of about 0.1 per mile, which means that in 10 miles' length the current or voltage drops in the ratio of 2.71828 . . . to 1, or by 1 napier. The extreme limit of telephonic speech with simple present-day carbon transmitter, induction coil, and Bell receiver is about 40 or 45 miles of standard cable, and for good speech about 25 miles. The attenuation of any other cable is now commonly expressed in its equivalent in miles of standard cable (M.S.C.). Owing to losses in subscribers' circuits and in the exchange connections the total attenuation in a long trunk line should not exceed that of 15 or 20 M.S.C.

(To be continued.)

ELECTRIFICATION OF THE FRENCH MIDI RAILWAY.*

By A. BACHELLERY, Ingénieur-en-Chef, Chemins de Fer du Midi, France.

(Continued from page 42.)

By these means, compensation was obtained for both electromagnetic and static induction. The whole line between Perpignan and Villefranche, 30 miles long, only fed at one end, is actually worked with single-phase current without any trouble on the telegraphs and telephones.

The outbreak of war brought these experiments to a standstill. The whole of the energy available from the existing power-houses, as well as from a new 25,000 kw. plant equipped at Eget during the war, was given over to munition work, and it was only after the Armistice that the company could resume work in the matter of electrification. In the meantime, however, things, from a technical point of view, had taken a new turn.

The French Government had decided to standardise for electric railways both the primary current and the traction current, in order that different power plants could work in parallel, and that locomotives could be used indiscriminately on all the electrified lines.

A Commission was appointed at the end of 1918 by the Ministry of Transport to decide on one system to be accepted by the French companies.

In 1920 this Commission, after close investigation of the different systems in use in France and abroad, produced its conclusions, which were adopted by the Government.

---

* Paper read before the I.E.E. on November 22, 1923

The primary current is to be three-phase, 50 cycles. The standard type of traction current is to be direct current at 1,500 volts, with the proviso that in exceptional cases, 3,000 volts can be used.

Either overhead or third-rail equipments are permitted, and locomotives are to be fitted with current-collecting apparatus suited to both.

The reasons for this choice were the following:—

Three-phase, 50-cycle current is already standard in France for distributing systems, and it was deemed advisable to adopt the same type for the power plants built by railway companies, in order to facilitate interconnection and mutual help, the result being not only greater security, but also better utilisation of both the power plants and transmission lines.

The type of primary current being thus fixed, the single-phase system loses one of its chief advantages, which is to do away with rotating machines in substations when low-periodicity current for traction can be directly produced at the power-house. The necessity for substations fitted with motor-generator sets for the production of single-phase current would have involved high expense and low efficiency, whereas the use of rotary converters for producing direct current allowed much more favourable conditions.

On the other hand, the use of direct current was considered to be the best means of overcoming inductive interference on low-tension conductors.

Other advantages were also considered, such as lower weight and cost of direct-current locomotives, greater overload capacity, and cheaper maintenance of their motors.

As to the voltage for traction lines, 1,500 volts was chosen as being the maximum voltage allowing the use of a third rail, which certain companies wished to keep, notwithstanding the advantages which a somewhat higher voltage might have procured.

These decisions implied for the Midi Company the abandonment of the larger part of the work already done. Power plants, transmission lines, substations, overhead equipment and locomotives had to be fundamentally modified to be used for the direct-current system.

The company set to work immediately on these alterations as well as on a new programme of electrification.

In two years' time the first results have been attained by the appearance on the Pau-Tarbes division, in the last months of 1922, of the first French 1,500-volt direct-current locomotives.

The electrification work is actually carried out in the western part of the Midi system. The Toulouse-Dax line is to be entirely equipped this year, and is already partly run by electricity. Its branch lines are being changed over from single-phase to direct current.

The equipment of the main line from Bordeaux to Hendave has been begun, as also of its branch lines to Arcachon and Biarritz. Other lines will follow both in the Pyrenees and the Cévennes districts, the whole length of road to be electrified in the next 10 years being nearly 2,000 miles.

(To be continued.)

Reviews of Books, &c.

[Books noticed in this column will be sent from ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

THE PRACTICAL ELECTRICIAN'S POCKET BOOK, 1924. (Rentell. 3s. net.)—The publishers have evidently profited by Monsieur Coué's formula, because every year and in every way the "Practical Electrician's Pocket Book" gets better and better. The present year brings the twenty-sixth edition of this old and familiar friend, which is welcomed by electrical engineers in all branches of the profession. Ample additions and careful revision keep it on the top line of progress, and, while it embraces many subjects, its strong point is its use in connection with present-day installation practice. It is, therefore, an invaluable and convenient pocket manual and companion for every contractor, foreman and wireman. In fact, it is of use to everyone interested in electric light and power.

The information on the many wiring systems now on the market is, indeed, most comprehensive, and its most complete tables of reference to central station and power supplies are in constant demand by all manufacturers of electrical apparatus.

The return to the pre-war binding will appeal as being a decided improvement on last year's edition, and the diary it contains, although not providing much space for notes, is an aid to business if used as a record for appointments. The scope of the diary is practically limited to this, but it is a point to which contractors' attention is particularly directed, as the profession must on no account be bracketed with the proverbial plumber for unpunctuality.

While it is still a real "pocket book," it will appeal to every enterprising electrical engineer, for its scope is wide and the information it contains condensed into precise and pointed paragraphs and chapters. It is only by constant reference to the index that one realises the large amount of knowledge contained within its covers. It answers practically every question likely to arise in the electrical contractor's sphere of interest, and the various tables of wire gauges, carrying capacities, depreciation allowances, fusing currents, etc., make it a useful addition to the office, desk or bookshelf.

Electricity is always developing, and the pocket book develops with it, as the chapters on broadcasting, etc., show. The publishers invite suggestions, which may help to widen the sphere of usefulness; at the same time, it is difficult to see how the scope of the book could be extended without defeating its aim as a pocket book, for as such it already has ample proportions.

The "Osram" advertisement on the cover states "Electric light is bottled sunshine." In turn, we may add that the "Practical Electrician's Pocket Book" is "bottled information," condensed and the best.

Aberdeen.—The Town Council, after consulting Mr. J. H. Rider, M.Inst.C.E., as to the Council's position with respect to the proposals contained in the Provisional Order being promoted by the Grampian E.S. Co., have agreed to present a petition against the Order on the ground that it would seriously interfere with and prejudice the Corporation electricity undertaking.

Questions and Answers by Practical Men.

RULES.

QUESTIONS : *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under " Answers to Correspondents " or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS : *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a " nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

Commencing with Question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words " Questions and Answers " or " Q " and " A " should be placed at the top left-hand corner of all letters intended for this column.

QUESTION No. 175.

When working a cinema projector on 200 volts A.C., 50-cycles, using about 15 amperes, with 3-bladed shutter on machine, an intermittent light was produced on the screen. The carbons were burning steadily and not spluttering. By using a single-bladed shutter a good picture was obtained. Can any reader explain this?—" OPERATOR."

QUESTION No. 176.

I have a foot-candle meter and the battery is run down, and, I am told, the meter will require recalibrating. Is this so, and, if it is so, how can I calibrate it?—" ILLUMINATOR."

(Replies to Questions Nos. 175 and 176 must be received not later than February 2, 1924.)

Various Items.

Smoking Concert.—The members of the Finsbury Technical College Old Students' Association will hold a smoking concert at the Engineers' Club, Coventry Street, W., on Wednesday, 20th inst., when the chair will be taken by the new President, Mr. A. J. Chapman, F.I.C., at 8 p.m. Tickets, 2s. 6d. each, from Mr. R. O. Grant, the Hon. Sec., at 70a, Basinghall Street, E.C.2.

Brighton.—Very special arrangements have been made at the Regent Town Hall to produce decorative effects with a note of colour by means of electric lighting, 4,322 Osram lamps having been used for the interior lighting. The general lighting is provided by Standard Clear Gasfilled Lamps, while the special decorative effects are carried out with coloured lamps. Nearly 2,000 Osram Gasfilled Colour-Sprayed lamps of various colours—yellow, flame, red, blue, etc., are disposed about the building, their lighting blending in a veritable kaleidoscope of multicoloured illumination and the effect is heightened by over 1,200 Osram Decoration Lamps of all colours, hanging in festons from the ceiling. In addition, 16 G.E.C. Floodlights equipped with Osram Gasfilled Lamps illuminate the exterior of the building in a very striking manner, and thus to decorative effect is added the publicity value of good illumination.

Institution of Public Lighting Engineers and Superintendents.—Arrangements have now been made for the inaugural meeting of this Institution at 2 p.m. on Friday, the 15th inst., at the Board Room of the Holborn Borough Council, 197, High Holborn, London, W.C.1, by the courtesy of the Council. The chair will be taken by Mr. S. B. Langlands, Lighting Superintendent of the City of Glasgow, the President of the Institution. Mr. Crane Cooper, of Wakefield, having relinquished the office of Secretary owing to pressure of business, Mr. W. J. Liberty, Public Lighting Inspector, City of London, Guildhall, E.C., has accepted the position of Hon. Secretary and Treasurer (*pro tem.*) until such time as the Institution has become established, and all applications for membership, etc., should be addressed to him. Full programme of the meeting and all particulars will be ready for issue in a few days and will be sent to applicants.

New Wireless Station in Argentina.—The new wireless station which has been built at Monte Grande for the Transradio Internaçional Cia Radiotelegrafica Argentina for the purpose of placing the Argentine in direct wireless communication with North America, Europe, and the Far East, was officially opened the other day, when an inaugural message was sent from the President of the Argentine to King George V. Direct services will be carried out between Monte Grande, New York, Paris and Berlin. It is intended to extend this direct service to England as soon as possible, but as Great Britain does not possess a wireless station sufficiently powerful to communicate with South America this service cannot be brought into operation until a suitable station is available in this country.

Reduced Fares to the British Industries Fair.—The forthcoming British Industries Fair, which will be held at the White City, London, from April 28 to May 9, and at the Castle Bromwich Aerodrome, Birmingham, from May 12 to 23 next, should establish a record for the numbers of trade buyers visiting it from all parts of the country. By a special arrangement between the railway groups and the Department of Overseas Trade, the organisers of the Fair, visitors will be able to make the return journey from anywhere in Great Britain at a cost of one and a-third of the ordinary single fare. Full particulars and forms of application for space can be obtained from the Secretary, British Industries Fair, Department of Overseas Trade, Old Queen Street, Westminster, S.W.1.

Standardisation of Colliery Requisites.—We understand that at the request of the Mining Association of Great Britain, the British Engineering Standards Assoc. has undertaken the standardisation of colliery requisites, and the progress of this work will undoubtedly be watched with keen interest by the country as a whole. We are informed that a fully representative committee is being set up under the chairmanship of Mr. Evan Williams, the President of the Mining Association, who are contributing to the funds of the B.E.S.A. to enable this important work to be carried out on an adequate basis. The Association, in unifying the needs of the industry—which, after all, is the fundamental significance of standardisation—will be doing much through the elimination of waste of time and material, and both the Mining Association of Great Britain as well as the B.E.S.A. are to be congratulated on the promotion of this co-operative movement, which has such vast possibilities for the good of the coal industry and the nation at large.

Trade Notes.

" Henley Commercial Information " for January 21 is a slip giving the market prices of copper, lead, india-rubber, and tin in London during the previous fortnight. This slip is issued fortnightly by **Messrs. Henley,** and is certain to be appreciated by all large purchasers of these standard metals and materials.

Mr. G. M. Stevenson, of 136, Yardley Wood Road, Moseley, Birmingham, who has been the representative in Birmingham of **T. W. Broadbent, Ltd.,** of the Victoria Electrical Works, Huddersfield, has now ceased to represent them, and has commenced business on his own account as an electrical contractor. All inquiries and orders from Birmingham and district should therefore be addressed to T. W. Broadbent, Ltd., at their head offices in Huddersfield.

Several new and interesting catalogues have been issued recently by the **Consolidated Pneumatic Tool Co., Ltd.,** of 170, Piccadilly, London, W.1, and will appeal to a very large number of users of small tools. Circular No. 89 illustrates and describes the Little Giant BQ-46 Hammer Drill, which is of the pneumatic type and is very suitable for road repair work, etc.; No. 90 deals with the C.P. Rock Drills, and catalogue No. 106 with the Duff Jacks, special types of which are made for jacking up cable reels, lifting motor armatures, etc. Finally catalogue No. 12E gives clear details and illustrations of the company's Little Giant Portable Electric Tools for all purposes, and in this the illustrations in themselves form a regular history of the company's widespread activities.

A stock list dated January, 1924, has been issued by **Mr. Fredk. Pratt,** the specialist in switch and fuse gear, of 66, Victoria Street, London, S.W.1, which contains details of various special lines and real " bargains " in Zed fuses, cleats, tumbler switches, etc., and should appeal to installation contractors generally. It is therefore to be hoped that an immediate application will be made for copies. They will be sent willingly.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

FEBRUARY 8, 1924.

CONTENTS. PAGE

Some Notes on the Magnetic Circuit 67
Registration of Electrical Contractors 68
Another "Record" 69
Shop-Window Lighting 70
Automatic Electric Pumping 70
Atmospherics and their Effect on Wireless Receivers .. 70
Current Topics 73
Problems in Telephony, Solved and Unsolved 75
Correspondence 76
Torsion Meters 76
Various Items 77
Reviews of Books 78
Trade Notes 78

SOME NOTES ON THE MAGNETIC CIRCUIT.

Analogy is often said to be the fruitful parent of error, nevertheless, much is sometimes gained in this way, and certainly so when we seek to learn something of the magnetic circuit by viewing it in close relation to the electric circuit. In the latter we have Ohm's Law expressed symbolically as

$$\text{Current} = \frac{\text{Electromotive force (E.M.F.)}}{\text{Resistance,}}$$

and in practical units this becomes

$$\text{Amperes} = \frac{\text{Volts.}}{\text{Ohms.}}$$

so, in the same way, in dealing with the magnetic circuit, we have

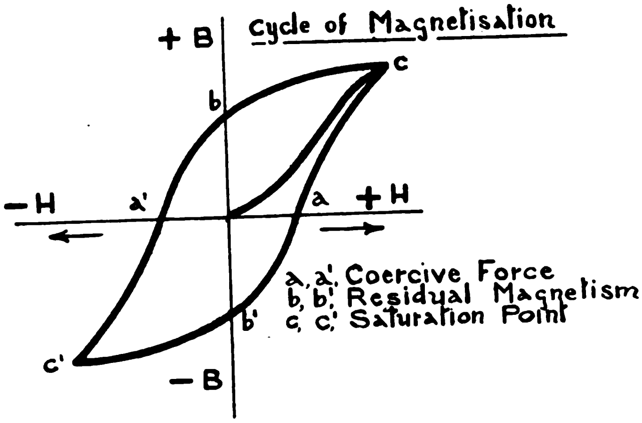
$$\text{Flux} = \frac{\text{Magnetomotive force (M.M.F.)}}{\text{Reluctance.}}$$

The three quantities in each closely compare with each other, viz., current and flux, E.M.F. and M.M.F., and resistance and reluctance. Elementary considerations, therefore, tell us that to obtain large current we reduce the resistance for the same E.M.F., and, similarly, to obtain large flux. we reduce the reluctance, i.e., the opposition to the passage of the lines of force for the same M.M.F. This is the reason why an iron path is provided for the flux in the magnetic circuit; iron armature, iron pole shoes, iron pole pieces, iron limbs and yoke of the field magnets—the only air path is the small gaps between poles and armature, and this is therefore the only place where much reluctance is experienced when we remember that, bulk for bulk, iron offers 2,000 to 1,500 times less reluctance than air or non-magnetic material.

This is the meaning that we attach to the word permeability. When a copper wire arranged as a helix has an electric current flowing it behaves as a magnet, and, therefore, a certain number of lines of force are induced; in other words, a magnetic field is set up. If a core of iron is placed inside the helix, we have, in effect, replaced a volume of air by an equal volume of iron, and the field is greatly increased. If we call H the number of lines induced in the former and B the number of lines induced in the latter, then, denoting the permeability as μ, we have $\mu = \frac{B}{H}$ or $B = \mu H$. μ is a variable number for different kinds of iron; for soft iron and steel it is high (about 2,000), and for cast-iron it is much less (about 1,500).

Intensity of Magnetisation.—When the iron of the core has been magnetised, the lines of force due to it becoming a magnet will reinforce those produced by the current in the helix. This is denoted by the letter k, and is called susceptibility. Calling the intensity of magnetisation I, we have the relation $I = kH$, and the total induction is therefore $4\pi I + H$ lines. Moreover, the ratio between $4\pi I$ and H is very great; the former may amount to thousands, while the latter may only be in units, and this obtains in practice in the dynamo field magnets and armature.

Cycle of Magnetisation and Demagnetisation.—The switching on and off of a current round the helix of wire containing an iron core is not so simple as, *a priori*, we would expect it to be with regard to induction. When the magnetising current (H) is gradually increased, B also increases, rapidly at first and then slower, until a saturation point is reached, and an increase of H does not give an increase in B. Further, when H is gradually reduced from this value to zero, the lines of induction fall in value, as we would expect, but a considerable number of lines are left in the iron when the current is nil. This quantity is called the residual magnetism for that sample of iron, and we can only reduce this to nothing by sending a current in the reverse direction through the helix. This point is called the coercive force, and, when the current is increased beyond this point, maximum B lines is again reached when H has reached the value as in the first part of the cycle. Continuing this operation, so that H falls to zero, another point is reached giving B lines of residual magnetism; and, carrying the cycle further until the first H value is obtained, we get the initial B value. This cycle of changes through which the iron goes can be represented graphicically thus:—



The whole phenomenon is called hysteresis, and much research work has been done in recent years resulting in a practical application in dynamo design, such as employing certain kinds of alloyed steel for the passage of the lines of force. The loss of power in watts per cycle becomes less when the area of the loop, as shown, becomes reduced.

Residual magnetism plays a part in the starting of a dynamo or motor. There is always a feeble field left after the current has ceased from a prior running of the machine, and, were it not for this, it would not so easily excite. The name retentivity is given to this property; soft iron we regard as a temporary magnet, but a small coercive force only is needed to reduce its residual magnetism to zero. On the other hand, hard steel requires a greater coercive force to demagnetise it; the field is retained, hence the name permanent magnet.

Permeabitity and Temperature.—When a field of force is weak and the iron rises slightly in temperature, the permeability becomes greater; with a strong field the permeability is decreased, and at high temperatures, such as that of red-hot steel, the permeability vanishes altogether.

REGISTRATION OF ELECTRICAL CONTRACTORS.

The launching of the National Register of Electrical Installation Contractors is a matter of such importance to several large sections of the industry and to the public that we feel certain our readers will wish to have before them the facts which have led up to the movement, and some indication of the objects in view and of the policy of the new body.

In the course of their deliberations of the revision of the Wiring Rules of the Institution of Electrical Engineers, the Wiring Rules Committee were faced with the problem of the attainment of a proper standard of wiring practice in the absence of any powers of compulsion, and the meeting together of representatives of so many interests afforded a useful opportunity of discussing this problem.

The pros and cons of compulsory Wiring Rules were fully examined, and it was found that, even though the difficulties in obtaining compulsory powers could be overcome, there was by no means unanimity as to the advantages of compulsion.

The compulsory registration of electrical installation contractors was also considered, and to this again serious objections could be seen. It was quite clear that the majority of contractors were desirous of carrying out work on sound principles, and it was felt that if some means could be found of eliminating the very small minority of ignorant, financially unsound and fraudulent contractors whose work tends to bring the entire contracting industry into disrepute, a tremendous step forward in the desired direction would be attained. The simplest and most effectual means available appeared to be the foundation of a body for the voluntary registration of contractors.

Acting on the principle that there is nothing electrical with which the I.E.E. is not concerned, while recognising that it is not a body which can properly conduct proceedings chiefly of a commercial nature, the Institution once more stepped in to "hold the umbrella" under which the various interests concerned could meet and deliberate, just as it had in the case of the E.R.A., the E.D.A., the Society of Radiographers, and others. The idea was to facilitate the early stages of the formation of an independent body governed by a Council formed of nominees of the various bodies interested, including the Institution of Electrical Engineers. That independent body has now been formed under the title of the National Register of Electrical Installation Contractors, and the licence of the Board of Trade, which has been obtained, has enabled it to become incorporated as an Association not for profit, but with limited liability, and liberty to drop the word "limited" from its title.

The first members who compose the Council, or as they are termed, "The Registration Board," are as follows:—

(*Alternate to Chairman.*) ** 1. P. V. Hunter, C.B.E. * 2. W. R. Rawlings. 3. W. M. Selvey. *Chairman.* * 4. C. H. Wordingham, C.B.E	Nominated by the Institution of Electrical Engineers.
* 5. S. E. Britton. * 6. E. Calver. * 7. F. W. Purse. * 8. Lt.-Col. W. A. Vignoles	Nominated by the Incorporated Municipal Electrical Association
* 9. H. J. Cash. 10. W. Cross. 11. W. A. Shaw. 12. W. H. Walton.	Nominated by the Electrical Contractors' Association.
13. Alexander Lindsay. *14. D. S. Munro. 15. A. B. Robertson, Junr.	Nominated by the Electrical Contractors' Association of Scotland.
16. A. E. Iliffe. 17. H. W. Roberts.	Nominated by the British Electrical and Allied Manufacturers' Association.
18. H. R. J. Burstall. *19. A. H. Dykes.	Nominated by the Association of Consulting Engineers.
20. W. Harrison. 21. P. M. Millns.	Nominated by the Electrical Wholesalers' Federation.
22 Max Clarke. 23. A. E. Munby.	Nominated by the Royal Institute of British Architects.
*24. A. G. Bruty. 25. F. G. Sherwood.	Nominated by the Irish Centre of Institution of Electrical Engineers.

Provision is made under the Articles of Association for adding nominees of other interested bodies who may wish to be represented on the Council, and already application has been made to that end.

The dominant objects, as expressed in the Memorandum of Association, are:—

(a) To afford to the public the means of distinguishing Electrical Installation Contractors who shall have given evidence of their competency, and undertaken the responsibility required by the Conditions of Registration under the powers contained therein.

(b) To raise the efficiency and status of Electrical Installation Contractors as a body in a manner consistent with the importance of their occupation, and in connection with the application and use of electricity for any purpose.

(c) For the foregoing purposes to set up, issue and maintain a Register for Great Britain, the Irish Free State, and Northern Ireland of

Electrical Installation Contractors qualified for Registration under the Rules and Regulations for the time being of the Association, and to issue certificates of registration thereunder.

The Registration Board have appointed ten of their members, marked thus *, as an Executive Committee to whom they have delegated certain executive powers. The Chairman of the Committee is Mr. C. H. Wordingham.

It is important that our readers should know the policy of the Committee in regard to admission to the Register. It is desired to open the door as wide as a reasonable discrimination makes possible, admitting every contractor, whether working on a small or large scale, who is able to carry out electrical installation work on reasonably safe and sound lines. Inasmuch as all certificates of registration have to be renewed yearly, it is felt that it will be much safer in the interests of all concerned to run the risk of such discrimination being at fault, and admitting a few individuals or firms who are subsequently found to be unsuitable, and whose certificates will not be renewed, rather than to shut out any who might have carried out satisfactory work.

It is not proposed to institute fresh rules or regulations, or in any way to set restrictions on the freedom of legitimate wiring business, nor in any way to increase the cost of electrical installation work.

Registered contractors will not be hampered by inspections or vexatious red tape, and only in the event of a complaint against a registered contractor, for which on *primâ facie* evidence there is good ground, will an investigation be made by the Executive. Such investigation, however, will be thorough and impartial, and should prove effectual in eliminating unfit or undesirable contractors, and debarring them from the benefits of registration.

It is confidently hoped that the foundation of the National Register will promote the interests alike of electrical installation contractors, electricity supply authorities, whether municipal or company, and the public generally, and at the same time further the spread of the use of electric light and electrical appliances, by giving the public greater confidence in those who carry out work on consumers' premises.

Obviously, the success of the scheme will depend in large measure upon the extent of the support which it receives from the contracting section of the industry, and we venture to hope that the foregoing brief account of the genesis and objects of the movement may have impressed our readers favourably, and enable them to give it their most cordial support.

HYDRO-ELECTRICITY IN WINNIPEG.

The hydro-electric system of Winnipeg is an outstanding example of the successful operation of a public utility under private ownership. Before the days of water-power in Winnipeg rates were excessively high, justified to some extent by the higher price of coal as compared with Eastern cities. In 1904 an agitation for a municipal plant was begun, culminating on a favourable vote on a by-law submitted to the people in June, 1906. From the beginning important factors contributed to the success of the undertaking. The first was, of course, the remarkably fine water-power site which the city obtained at Point du Bois, the development of which resulted in a cost per h.p. of less than £10, which compares favourably with the approximate cost of £40 per h.p. of the Chippawa development at Niagara Falls.

Since the installation of the plant great things have been accomplished. The electric rates have been cut to one-third, and it is estimated that citizens have saved at least £3,000,000 in their electricity bills. When the rates were cut from 5d. to 1½d. it was found that the consumption per consumer was increased 100 per cent.

The capacity of the plant is 100,000 h.p., but the peak load this year did not exceed 50,000 h.p. This is as it should be, since the failure of many hydro-electrical schemes lies in the fact that when the water-power was harnessed the maximum advantage was not taken of the whole of the resources.

ANOTHER "RECORD."

We have had the pleasure of inspecting the new "Record" ohmmeter and generator manufactured by the Record Electrical Co., Broadheath, Manchester, which is very similar to the original model described in these columns a few years ago, but its weight is reduced to 6 lb. and its dimensions have been reduced to 7¾ by 5½ by 4¾ in. The instrument is neat, compact and exceptionally well made, the brush gear being exceedingly simple yet effective. The outstanding feature is that the ohmmeter is entirely dustproof—a decided advantage. The generator may be removed from the case by merely removing a few screws from the base, and the screw-holes are bushed with countersunk brass bushes, thus eliminating distortion. The instrument should find a ready market with central station engineers and mains supervisors. Prices, etc., will be sent upon application to the offices of the company.

Tenders Accepted.—The tenders of the Ediswan Electric Co., Ltd., for the supply of various types of lamps have been accepted by the Booth, Cunard and Canadian Pacific Steamship Companies. Their tender has also been accepted by the War Office for the supply of inert cells and dry cells, and by the Formby Council for 200 meters.

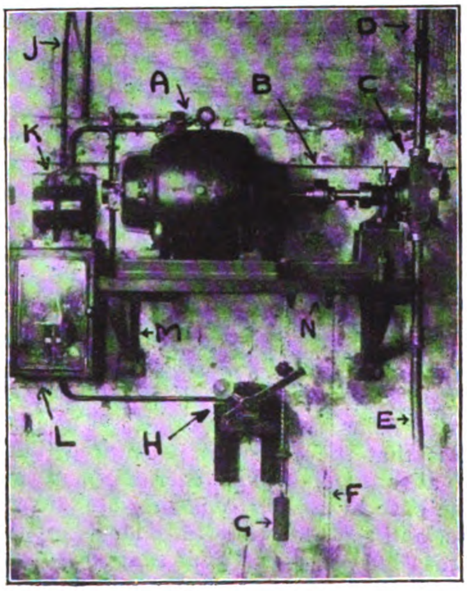
East Africa.—We have received from the Dept. of Overseas Trade a report on the trade of East Africa, which is published officially by H.M. Stationery Office, price 1s. 6d. net, or 1s. 8d. post free from ELECTRICITY Office. On page 20 there is an interesting paragraph stating that the United Kingdom now virtually controls this particular market for electrical goods and apparatus.

SHOP-WINDOW LIGHTING.

The G.E. Co., Ltd., have installed in their main showrooms at Magnet House, Kingsway, London, W.C.2, a complete model shop window, in order that they may be in a position to demonstrate the value of the "Gecoray" lighting system to all those who are interested in this subject. The equipment of the window is very complete, a double bank of "Gecoray" mirrored glass reflectors being installed, with switches to enable both ordinary and colour light effects, daylights effects with "Osram" gasfilled daylight lamps, spot lighting and flood lighting to be demonstrated with the greatest ease. Contractors, architects and others interested in shop-window lighting problems are always welcome at Magnet House, and the illuminating engineers of the company are always willing to give special demonstrations to any inquirer. It is certainly well worth a visit, and this fresh example of G.E.C. enterprise should have a very material effect upon the standard of window lighting in this country.

AUTOMATIC ELECTRIC PUMPING.

A little while back there was an excellent description in the *Engineering Gazette* of the automatic electric pumping equipment which Marryat and Place have developed for clearing basements and sumps of drainage water. So much interest has been taken in this automatic gear that the firm has received an immense number of inquiries for sets arranged for similar purposes. These inquiries arrive from practically all parts of the country and every conceivable trade.



The photograph on this page illustrates a little equipment put in by Mesrs. M. and P. for the London and Edinburgh Steamship Co., Ltd., for clearing out water from their vaults and engine-room, in which capacity it has been most highly satisfactory.

The general arrangement follows the lines of those previously supplied. For instance, following the lettering indicated upon the photograph, A is an electric motor driving pump C through flexible coupling B; D, discharge pipe; E, suction pipe taking water from sump hole, which is provided to collect the drainage water; F, chain, one end fixed to and carrying a copper ball float, floating in water in sump hole, at other end of chain is a counterweight G, chain is also provided with two stops; H, float switch, operated by chain and stops by means of the float in sump rising and falling with the water level. Electric current is brought in from supply company's mains by means of wires in tube J entering the double-pole switch K, and then into the automatically operated solenoid controller LM are wall-brackets carrying motor and pump on a bedplate; N, two pulleys for chain to run over.

The action is as follows: As the water accumulates and rises in the sump hole, the copper float and chain also rises over pulleys; the chain and counterweight and stop closes the float switch, so making electric circuit to the automatic controller, which starts up the motor and pumping commences. As the water level is lowered, the float, etc., drops and brings off the float switch at a predetermined minimum level, and the motor stops until such time as the water again reaches a predetermined maximum height.

Thus the pump is entirely automatic and may be left to look after itself. It may not be required for days or months, yet, whenever the water rises, it will automatically come into action. Floods have occurred in basements during a night, sometimes doing extensive damage. This automatic apparatus deals admirably with such events.

ATMOSPHERICS AND THEIR EFFECT ON WIRELESS RECEIVERS.*

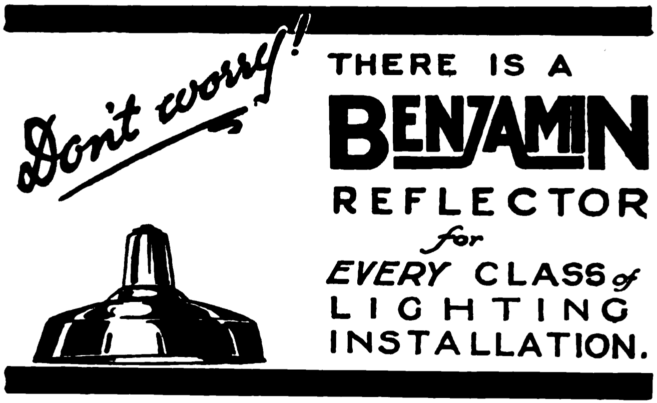
BY E. B. MOULLIN, M.A., ASSOCIATE MEMBER.

This paper contains a mathematical analysis of the effect of an atmospheric upon a wireless receiver. The choice of functions representing the atmospheric has been governed by information contained in *Proceedings of the Royal Society*, A, vol. 103. The effect of each of several wave-forms is calculated and the results are compared. The effect is calculated of an atmospheric acting respectively on an attuned antenna, an aperiodic antenna, on a tuned loop aerial, and also the combination of each of these with a selected amplifier. In each case a formula is derived which gives the ratio of signal to atmospheric, and it is shown that for a given wave-length these formulæ are identical. The possible advantage to be got from the use of an aperiodic antenna or of a slightly distuned periodic circuit is considered in detail. Finally, the rectified current produced by the atmospheric is compared to that produced by the signal, and it is shown that the decrement of the aerial should always be reduced to the point where ringing or bad shaping of signals commences.

Radio Sets Banned.—The Chinese Ministry of Communications has issued an order that hereafter no wireless or radio sets may be sold or installed by Chinese citizens, as such is against the country's law, and offenders will be severely punished. Foreigners living in Chinese territory also come under this order. Steps are being taken to prevent the sale of these sets to, or their installation by, Chinese living in foreign settlements.

---

* Summary of paper read recently before the I.E.E.



Don't worry! THERE IS A BENJAMIN REFLECTOR for EVERY CLASS of LIGHTING INSTALLATION.

Advert. of the Benjamin Electric Ltd., Brantwood Works, Tariff Road, N.7.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and Abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Tuesday morning, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

Those Accumulators.

With the introduction of broadcasting there has revived a correspondingly increased demand for the smaller portable storage battery in various ampere-hour capacities to furnish the necessary current for incandescing the valve filaments of valve receiving sets. One comes across all sorts and conditions of these batteries, and I personally am strongly reminded of the days when motor-car ignition depended upon the same untrustworthy source of current for producing a spark through the medium of induction coil and "make and break." History repeats itself, and, in so far as the smaller portable type of storage battery is concerned, we are to-day up against just the same drawbacks and difficulties as in those early days of the automobile movement. It is not the fault of the battery manufacturers; they have produced quite excellent examples of small storage batteries specially designed for wireless purposes.

The trouble is inherent in the lead-acid accumulator; it is not a piece of electrical apparatus suitable for placing in the hands of the lay public; it still remains essentially a laboratory article, and will only function satisfactorily if looked after by experienced people, kept properly charged, and, most important, worked regularly at its rated amperage. The best and most robustly constructed lead-acid accumulator can be absolutely ruined in less than three months by unconscious neglect on its owner's part, or by corresponding ill-treatment at one or other of the many so-called charging depots which have sprung up to cater for the requirements of listeners-in. Although it is possible to get accumulators charged in almost any town or even village nowadays, the quality of the charge in nine cases out of ten is open to question, and there is probably more damage done to accumulators at these places than can well be imagined by the users of wireless sets.

I have myself seen all sorts and sizes of these batteries set up on a so-called charging bench, connected in series, without regard to size, number of plates, condition, or any other vital factor, merrily boiling away on the charging rate which is, perhaps, approximately suitable for one battery in the chain. Clients call for their batteries fondly imagining that they are getting all the current they have paid for, only to find that their valves after an hour or so at full load suddenly die away to the feeble red-hot hairpin stage indicative of an exhausted battery half-way through an attractive programme. It is to this serious disability that we owe the development of the dull-emitter type of valve, with its considerably reduced filament current, enabling it to be energised by means of dry batteries, or, at all events, an accumulator of negligible ampere-hour capacity. In this respect the dull-emitter is performing precisely the same function in the development of broadcasting as the magneto performed in connection with motor-cars. If we had to rely on accumulators for ignition to-day, the motoring movement would not have made anything like the progress it has done.

I do not suggest that all accumulators are neglected; the expert realises what is due to these essentially weak links in a wireless installation, and looks after them accordingly. In the interests of wireless broadcasting and a continuance of its popularity it is up to the trade to find an antidote for the battery trouble; otherwise, as time goes on, and the public realise what a nuisance and constant source of expense they can become under certain conditions, they will lose interest in the new pastime. The policy adopted by certain firms of undertaking the collection and charging of wireless batteries under nominal contract terms is perfectly sound and calculated to overcome this very real disability. I strongly urge all dealers in wireless apparatus who have the future of the industry at heart and do not regard it in the light of a passing craze to look well after this part of their business. It is not sufficient to sell an accumulator with a wireless set and lose all further interest in it; such a policy ultimately means a dissatisfied client.

Kerb Lighting.

My thanks are due to a correspondent for his very interesting letter on this subject, which appeared in last week's issue. I was not aware that the idea had actually been tried in the States, but it is quite possible. I realise the objections he raises, particularly the question of false shadows. One sees the same phenomenon when the head-light beams of a car are reflected from quite minor irregularities in the surface of a dry road. These insignificant depressions are made to assume the proportions of huge cavities and one gets the impression that the road is actually full of potholes. On the other hand, quite good progress has been made in connection with so-called "flood" lighting in America, and we have several excellent examples of this lighting over here as applied to the exteriors of important buildings. On a somewhat more ambitious scale this is much the same class of illumination applied to a vertical surface as that proposed in connection with kerbside units.

Those Breakdowns.

Since I last touched on this subject there has been quite a lengthy list of failures in electricity supply up and down the country, including several of the more important provincial towns. I do not propose to give a list, as most of them have been reported in the local press at the time of their occurrence, but there is one point which crops up in connection with these all too frequent extinctions at inopportune moments, and that is in connection with hospital lighting. In two cases at Loughborough and Bradford respectively, surgeons were actually operating on patients when the light failed, and, but for the presence of mind of nurses and attendants in the one case, and the forethought of the lady surgeon in another, the result might have been serious to the unfortunate patients under an anæsthetic. In view of the ever-possible contingency of sudden extinction of lights in an operating theatre there should invariably be alternative emergency lighting units fed from a stand-by source. A battery is sufficient to feed one or two of the more important lights in such a case, and the installation can readily be arranged for relay control, such that the extinction of the main lights automatically switches on the secondary units. Consultants for hospital lighting equipments would be well advised to provide for such emergencies when drawing up their specifications. It may be the means of saving life in similar emergencies.

Through another failure in a London district the testing of patients' eyes at the Royal Eye Hospital had to be deferred on account of the absence of electric light which was essential to the testing process. Whilst on this subject, I must congratulate Clacton electricity consumers on the promptitude with which their electricity supply was restored after the very serious fire at the local generating station. It was anticipated at the time that fully six months would elapse before the supply was again available; but thanks to the unremitting energies of the staff current is again available, a fact which reflects very great credit on all concerned. It will be remembered that this conflagration had its origin in the accidental firing of the oil-fuel upon which this station is run.

On Making the Best of It.

The article under this heading which was contributed to the December issue of *The Woman Engineer*, by Mr. Andrew Stewart, M.I.E.E., Director of the Consolidated Pneumatic Tool Co., Ltd., is likely to interest a far wider circle of readers than those members of the fair sex who are making an enthusiastic study of the science and practice of engineering. In fact, it is an excellent lecture to the young engineer or student who is on the threshold of life as a business career, and is worthy of careful study because of the sound practical advice which it contains. It is all the more pleasing to me, because I can well remember the many excellent technical articles and serials which Mr. Stewart has contributed to the pages of ELECTRICITY during the course of his steady climb up the ladder of commercial success. He writes from actual and successful experience, so his advice is well worth most careful attention.

Registration of Electrical Contractors.

I have much pleasure in directing the attention of my contractor readers to the official advertisement announcing the incorporation of the "National Register of Electrical Installation Contractors," under the auspices of the important institutions and societies whose names are quoted therein, and I hope there will be a prompt and hearty response to the invitation to register. It will confer an important status on all who are admitted, and a careful perusal of the descriptive editorial, which appears in another column, will, I feel certain, convince my readers of its manifest advantages.

British Carbons for British Films.

I know that a very large number of the kinematograph operators of this country are regular readers of ELECTRICITY, and as a "British Film Week" is now running in order to promote the success and popularity of the British film, it is also a good opportunity to shout loudly on behalf of the British made kinematograph carbons, for the simple reason that, in spite of the inclusion of arc lamp carbons in Schedule A. of the Safeguarding of Industries Act, it is a fact that large quantities of Austrian and German carbons are being imported into this country at extremely low prices, so that the existence of British carbon works is once again endangered.

All British-made carbons are manufactured at the carbon works of the General Electric Co., Ltd., at Witton, near Birmingham. These works, which I have visited on several occasions, have always been a target for the attacks of foreign manufacturers, and before the war price-cutting had progressed to such a point that they were only kept going at considerable expense. This was done purely for patriotic reasons, as the directors of the G.E.C. realised the vital necessity for ample supplies of carbons to be available in case of war. When the war broke out their foresight was fully justified. At the very outbreak of hostilities special arrangements had to be made to satisfy the demands of our Army and Navy, and at the same time keep the essential services going.

With the assistance of H.M. Government the works were increased in size, and the G.E.C. made every endeavour to deal with all demands, with the result that it was possible to provide sufficient kinematograph carbons to keep the kinematograph theatres in this country supplied, and it should not be forgotten that without the General Electric Co., Ltd., most of the kinematograph theatres in this country would have been closed down during the war owing to lack of carbons.

At the conclusion of the war the Government, realising the importance of the carbon industry to this country, did their very best to afford protection to the G.E.C. carbon works by including carbons in Schedule A. of the Safeguarding of Industries Act. Owing, however, to the depreciation of Continental currencies beyond all expectations, this protection was practically of no avail, and large quantities of Continental carbons were, and still are, being imported at very low prices. This ruinous competition, however, would achieve but small effects if all exhibitors in this country would remember the services rendered to them by the G.E.C. during the war.

The continued existence of the carbon works would be assured if all British exhibitors would make a point of employing only British carbons. The carbon bill for any theatre is a very small sum compared with the large prices which are paid weekly for expensive films, and the difference in price between foreign and British-made carbons would be such a small proportion of the total expenditure, that it would appear, on patriotic grounds alone, to be well worth while to use British made carbons exclusively, for then employment would be assured to a large number of British workpeople, and the existence of the Carbon Works safeguarded in readiness for any other national emergency.

I understand the G.E.C. are now putting on the market a new type of Kinarko Carbon suitable for the mirror arc lamps which have been introduced during the past few months. These carbons are at least equal in quality to the foreign carbons at present being rushed in, and I do most sincerely hope that this brief account of the history of the British carbon industry will lead all right-thinking and patriotic kinematograph exhibitors in this country to adopt the motto which appears at the head of this article: "BRITISH CARBONS FOR BRITISH FILMS."

ELEKTRON.

PROBLEMS IN TELEPHONY, SOLVED AND UNSOLVED.*

By PROFESSOR J. A. FLEMING, M.A., D.Sc., F.R.S.

(*Continued from page* 64.)

Pupin's important contribution to the subject of the inductive loading of cables consisted in the proof he gave that the added inductance could be inserted in the form of inductance or loading coils spaced at equal intervals in the line, provided these coil intervals were not more than about one-tenth of the mean wavelength of the speech electric-current waves on the so-loaded cable. Aerial lines and cables began to be loaded in this fashion soon after 1900, with the result that the normal speech range was extended. It is possible to load with coils so as to increase the line inductance from 10 to 250 times that of the unloaded line. Considerable research has, however, been necessary to find the best form of loading coil. Those first used consisted of a ring-shaped iron core formed of fine iron wire, overwound with two circuits of insulated copper wire for the lead and return circuits so wound as to produce a poleless circular magnetisation in the core. In such a wire core the alternating telephonic currents dissipate energy as eddy current and hysteresis loss, and this is equivalent to an increase in the effective resistance of the coils. The problem then was to find a method of making an iron ring in which eddy-current loss should be nearly absent and hysteresis loss small, but permeability sufficiently large to give the required inductance to the coil. The problem was solved by the Western Electric Company of America after great research. These iron cores (called "dust cores") are now made as follows:—

Electrolytically deposited iron is ground up into a powder and the iron grains are coated with zinc dust. The particles are then mixed with shellac as a cement and compressed under 100 tons per square inch into flat rings, which are piled one on the other to make the loading-coil core. This material when subjected to an alternating magnetic force of a frequency 100 to 2,500 p.p.s. has an average magnetic permeability of 34 to 50 when the magnetic flux density is only about 2 C.G.S. lines per cm^2. The electric conductivity is extremely small (about 1/80,000th part of that of solid iron), so that eddy current loss is absent, and hysteresis loss is also very small. The details of one type of loading coil with dust core are as follows: Inductance at 800 p.p.s. and 1 mA = 0.177 H. Effective resistance 9.2 ohms. The core composed of 7 dust rings has a cross-section of 8.3 cm^2 and 24.9 cm mean length. Mean permeability at a magnetising force of 0.0564 = 34. The total turns of wire on the ring are 1,120, put on in 4 separate sections on the 4 quadrants, and two such coils in series are inserted in the lead and return of the telephone circuit.

In the case of underground cables it is customary to space the loading coils about 2 to 2.5 miles apart and to give them such inductance as to add about 55 mH per mile run of the cable. The ratio of R'/L for each coil is about 50. Lighter or heavier loading is, however, often employed.

For these loaded lines the attenuation constant (a) can easily be proved to be given by the expression $a = \frac{1}{2}[(R/L)+(S/C)]\sqrt{(CL)}$, where R and L denote the total effective resistance and inductance of the line per mile of loop, and S and C the leakance and capacity. It is seen, therefore, that the insulation resistance of the loading coil, as well as that of the line, must be very high if the effect of the added inductance is not to be nullified by the leakance.

In aerial telephone lines the loading coils are placed from 8 to 12 miles apart and have each an inductance of about 0.25 H or less, so as to give the line a total inductance of about 40 mH or so per mile of loop. The coils are put in iron boxes attached to the telegraph posts. In aerial lines one difficulty of securing the full advantage of loading is the ever-varying leakance of the line.* The longest aerial loaded telephone line in the world is the New York-San Francisco-Los Angeles line of the American Telephone and Telegraph Company, which is 3,790 miles in length and was completed in 1916. It is loaded every 8 miles with coils having an inductance of 0.25 H and 6.5 ohms effective resistance, giving the line an average inductance of 37 mH per loop mile. This reduces the attenuation constant to 0.00125. The electric wave therefore runs 800 miles before its amplitude is reduced to 36.7 per cent. of its initial value, or by 1 napier. Another long aerial loaded line is the Berlin-Rome line, 1,300 miles in length, in which loading coils are inserted every 10 km. or 6¼ miles, each coil having an inductance of 0.2 H, thus raising the average inductance of the line to 22 mH per loop kilometre and reducing the attenuation to 0.0011 per kilometre of loop.

---

* Lecture delivered before the Institution of Electrical Engineers, to whom we are indebted for the illustrations.

* Valuable information on this subject was given in 1914 by Mr. J. G. Hill, of the General Post Office, in a paper on "The Loading of Aerial Lines and the Constants of Loaded Circuits" which was read before the Institution of Post Office Electrical Engineers. (Price 1s. 2d., post free, from *Electricity* Office.)

(13) It was a more difficult problem to load with coils a submarine cable, but this was successfully accomplished by Messrs. Siemens Bros. in the English Channel telephone cable laid by the British Post Office in 1910. The details were described in a valuable paper read before this Institution in 1910 by Lt.-Colonel W. A. J. O'Meara, at that time Engineer-in-Chief to the British Post Office.*

Inductance coils of special construction were designed for enclosure within the gutta-percha insulation and armouring of the cable, the coils having an inductance of 0.1 H at 750 p.p.s. and being placed at intervals of 1 naut (=1.153 miles).

The insertion of the coils required an increase in the diameter of the finished cable at intervals of 1 naut, but it was not too great to permit the cable being handled and laid in the relatively shallow water of the Channel.

(To be continued.)

Correspondence.

QUESTIONS AND ANSWERS.

To the Editor of ELECTRICITY.

SIR,—Permit me to correct my error in answer to Question No. 169, referred to by Mr. Platt in your current issue.

Commencing at col. 1, line 2, p. 36, instead of C^2R read CR.

Drop in volts in the resistance = CR.

$$\therefore \quad 200 - 25 = 15\,R.$$

$$R = \frac{175}{15} = 11.66\ \omega.$$

By multiplying the number of spirals given in table 2 by 15, the correct length of wire will be determined.

I would have corrected earlier, but considered that the two previous answers made the matter clear, since the slip was rather obvious, but then they always are—afterwards.—D. J. WILSON, Cudworth, Yorks.

WIRELESS.

To the Editor of ELECTRICITY.

SIR,—With reference to the report from the R.M.S. *Aquitania* that the chief wireless operator has succeeded in receiving two wireless messages simultaneously on two aerials, it is interesting to record that, in his early experiments in 1900, Senatore Marconi demonstrated the possibility of receiving two wireless messages on different wave-lengths simultaneously with one aerial. Describing this achievement in the *Times* of October 4, 1900, Professor J. A. Fleming said :—

> "These experiments have been conducted between two stations, one in Poole, in Dorset, and the other near St. Catherine's, in the Isle of Wight. The two operators at St. Catherine's were instructed to send simultaneously two different wireless messages to Poole, and without delay or mistake the two were correctly recorded and printed down at the same time in Morse signals on the tapes of the two corresponding receivers at Poole.
>
> "In this first demonstration each receiver was connected to its own independent aerial wire hung from the same mast. But greater wonders followed. Mr. Marconi placed the receivers at Poole one on the top of the other, and connected them both to one and the same wire, about 40 ft. in length, attached to a mast. I then asked to have two messages sent at the same moment by the operators at St. Catherine's, one in English and the other in French. Without failure each receiver at Poole rolled out its proper tape, the message in English perfect on one, and that in French on the other. When it is realised that these visible dots and dashes are the results of trains of intermingled electric waves rushing with the speed of light across the intervening 30 miles, caught on one and the same short aerial wire, and disentangled and sorted out automatically by the two machines into intelligible messages in different languages, the wonder of it all cannot but strike the mind."

The method of using two or more aerials for the purpose of receiving a corresponding number of messages at the same time is well known, and is utilised where necessary by the Marconi Company both on land and at sea. Yours faithfully,

W. W. BRADFIELD,
Joint General Manager.

The Marconi International Marine
Communication Co., Ltd.,
January 30, 1924.

TORSION METERS.

On Friday, February 1, Mr. J. Ward, B.Sc., M.I.Mar.E., delivered a lecturette on "Torsion Meters" at the Junior Inst. of Engineers. The torsion meter has an important function in the test shop as well as in trials, and Mr. Ward described the principles of several makes, including the Beris-Gibson, Amsler, Hopkinson-Thring, and Denny-Edgecombe. The Hopkinson-Thring is the one that is used in most of the ships of the Navy, and Messrs. Siemens Bros. and Co., Ltd., had kindly loaned one of the smaller sizes of this type for demonstration.

The length of shaft over which the twist is measured may be reduced to a length of twelve inches, and the angle of twist is read by means of the movement of a mirror fixed to a collar on the shaft. The mirror is tilted when a second collar moves relative to the first, and an image of a straight filament lamp is reflected on to a ground-glass scale, giving a reading which is proportional to the twist in the shaft. The shaft horse-power is readily calculated by multiplying the scale reading by the r.p.m. and a constant.

Since the introduction of double-reduction gearing to turbines, the revolutions have dropped down to about one hundred, and the image is not well defined, showing that there is variation in torque due to vibration of a very irregular and complex character.

The inventors of all these types of instruments, optical, electrical and mechanical, were engineers who had a sound knowledge of the physical sciences, and although junior engineers rather incline to begrudge the time they have to spend at physics lectures and laboratories, the lecturer's advice to them was to grind in the principles thoroughly, and then the practical applications would easily follow.

---

* See *Journal I.E.E.*, 1911, vol. 46, p. 309.

Various Items.

Tenders Accepted.—The Admiralty have just placed an important part contract for the supply of carbon filament lamps with the General Electric Co., Ltd.

Concert.—The next concert (ladies' night) of the Electro-Harmonic Society will be held in the Caxton Hall, Westminster, to-night (Friday, the 8th inst.) at 8 o'clock. Chairman, Dr. W. H. Eccles, D.Sc., F.R.S.

Meetings.—The Inst. of Engineers-in-Charge will meet at St. Bride Institute, Bride Lane, Fleet Street, E.C.4, on Wednesday, the 13th inst., at 7.30 p.m. Paper:—"Electrical Breakdowns and Methods of Prevention," by E. Mudd, Esq.

West Riding Electricity District: Local Inquiry.—The Electricity Commissioners will commence the inquiry on Wednesday, the 13th inst., at 10.30 a.m., in the Council Chamber, Town Hall, Bradford, and will sit from day to day until the inquiry is concluded.

Calendars.—A ready solid and useful scribbling pad, with calendar attached, is being issued to the clients of the Macintosh Cable Co., Ltd., who are making such big strides with their surface wiring system. It is certain to be appreciated by all contractors and installation engineers.

Faraday Medal.—The Council of the I.E.E. have made the third award of the Faraday medal to Dr. S. Z. de Ferranti, a Past-President of the Institution. Dr. Ferranti was a pioneer in the supply of electricity, and his early grasp of the fundamental principles of electric power supply have had a profound influence not only in this country, but all over the world.

E.D.A. Salesmanship Conferences.—The sixth Sales Conference of the present session will be held at the London School of Economics, Houghton Street, Aldwych, W.C.2, on Friday, February 15, 1924, at 7.30 p.m. Paper by Mr. R. A. Lower, A.M.I.E.E., on "How We Placed the First Hundred Cookers." Chairman, Mr. L. L. Robinson, M.I.E.E., M.I.C.E.

The Engineers' Club.—The following is a list of the meetings for February which are of direct interest to our readers, viz.:—February 8, Inst. of Aeronautical Engineers; 12th, Mining Electrical Engineers; 14th, Inst. of Production Engineers; 15th, Diesel Engine Users' Assocn.; 22nd, Inst. of Aeronautical Engineers; 29th, Inst. of Mech. Engineers, Graduates' Section.

Hayti.—Reports have been published by the Dept. of Overseas Trade dealing with conditions of trade and the trade outlook generally in the Dominican Republic and also in the Republic of Hayti. They will interest British export merchants who wish to open up trade in these countries, in which there is certainly an important market for our goods, provided that the prices can be quoted at competitive figures. The report may be obtained from H.M. Stationery Office, price 1s. 6d. net, or 1s. 8d. net post free from ELECTRICITY Office.

The S.A. Inst. E.E.—The November issue of "Transactions of the S.A. Inst. of Electrical Engineers" contains a most interesting paper on the testing of turbo-generating and turbo-compressing plant, with special reference to the machines of the Curtiss-Rateau type. There is also a paper on "Oscillograms," read by Mr. E. M. Dall at the meeting of the wireless section of the Institute, which contains some very practical and useful illustrations of the work carried out by the author.

"The Centralisation of Cord Repairs."—This is the title of a very interesting and practical paper read some months back before the Inst. of P.O. Electrical Engineers by Mr. G. F. Bellwood, A.M.I.E.E. It has now been reprinted in pamphlet form, representing thirty-eight cr. 8vo pages, including diagrams, and will appeal to all telephone exchange engineers as well as the employees who are engaged in this particular section of departmental work. The price is 11d. net post free from Messrs. Renteil, 36, Maiden Lane, London, W.C.2.

The Institute of Metals.—The annual general meeting of this Institute will be held at the Inst. of Mech. Engineers, Storey's Gate, Westminster, on Wednesday and Thursday, March 12 and 13, commencing each day at 10.30 a.m., when fourteen communications are due for presentation and discussion. The annual dinner of the Institute will be held at the Trocadero Restaurant on Wednesday, March 12. It is of interest to note that the membership passed the 1,500 mark on December 31, 1923, and it is hoped by the Council that as a result of the many activities of the Institute during the present year—particularly in connection with the British Empire Exhibition—this figure will be substantially increased before the end of 1924.

Obituary.—We regret to announce the death of Mr. George Watson Kidd, chairman of the board of directors of the Hart Accumulator Co., Ltd., of Stratford, London, who passed away suddenly on Tuesday afternoon, the 22nd ult., at his Wanstead home, "Taymouth," St. Mary's Avenue.

Artificial Reddle Invented.—Two Chinese merchants, Hu Pei-tang and Chang Siu-yen, have invented a method of making artificial reddle for red paint by electricity. The manufactured product is said to surpass the natural product in colour and in lustre. An office has been established in Hankow for its sale. Reddle is a mineral occurring in Hupeh, and is used as a red paint.

Diesel Engine Users' Association.—We have just received the report of the Hon. Sec., Mr. Percy Still, M.I.E.E., on the work of the association for the year 1923. It gives much information of interest regarding the functions of the various committees and the information which has been obtained from the members, as well as in regard to papers which have been read and discussed.

Annual Dinner and Reunion.—The annual dinner and reunion of the Institution of Electrical Engineers will be held at the Hotel Cecil, Strand, W.C., on Thursday, 21st inst., under the presidency of Dr. Alexander Russell, M.A., supported by the Council. Application for tickets should be made as early as possible, and in any case not later than Saturday, February 16. The charge is 12s. 6d. for each cover, exclusive of wine.

Hampstead.—The use of White Osram Gasfilled Lamps for lighting main streets which was inaugurated just before Christmas by the St. Marylebone Borough Council, has now been extended to the area of the Hampstead Borough Council, which has recently ordered through Messrs. William White and Co. 48 60-watt White Osram Gasfilled Lamps and 48 100-watt White Osram Gasfilled Lamps to be used in the ordinary converted gas standards for street lighting, a change which is certain to be much appreciated by travellers on fast-moving vehicles.

Motor-vessels.—The rapid growth of the motor-ship is indicated in this month's *Motor Ship* from the following official figures: In 1922 the motor-ship tonnage launched represented about 9 per cent. of the steamer tonnage. In 1923 the figure had increased to 16¼ per cent., and at the present time motor-ships under construction are equivalent to 35 per cent. of the steam tonnage. There is thus a rapidly increasing tendency towards the adoption of oil-engine propulsion. The same issue of the paper contains interesting articles dealing with an electrically operated device for grinding in Diesel-engine valves and the electric control of a large American Diesel engine.

Plant Wanted.—The Victorian Ry. Commissioners invite tenders for the supply and delivery at Melbourne of one air compressor complete with accessories and one set of electrical equipment for driving the compressor.——The Copenhagen Lighting Dept. invite tenders for the supply and erection of switchgear for 6,000 and 30,000 volts respectively.——The Administration of the Province of Antwerp invite tenders for the supply and erection of an electric power distribution system for the communes of Beersse, Herenthals, Gheel, Moll, Arendonck, Turnhout, Beerse. The contract includes the installation of high-tension lines with all accessories and the construction and equipment of transformer cabins. Specifications, etc., at the D.O.T. (Room 52), 35, Old Queen Street, S.W.1.

Freemasonry.—At the regular meeting of the Kelvin Lodge, held at Mark Masons' Hall, Great Queen Street, W.C.2, on Friday, the 25th ult., the members and visitors were afforded a real masonic treat in the form of a most interesting and instructive lecture on "Celestial and Terrestrial Symbolism," which was delivered by the Hon. Sir John Cockburn, K.C.M.G., who also holds high masonic rank in South Australia, for which colony he was for many years Agent-General in Great Britain. In the course of his lecture Sir John had occasion to refer to certain portions of the lodge furniture, and as a result of his examination he was able to congratulate the members on the fact that they were maintaining the reputation for accuracy which would ever be associated with the distinguished scientist whose name they commemorate so worthily. At the conclusion of the address the W.M., Mr. Andrew Forbes Dick, moved, and Mr. E. E. Sharp seconded, a very hearty vote of thanks to Sir John for his kindness in giving them all such an instructive lecture, and it is needless to say the proposal was carried with acclamation. The meeting was attended by Sir Frederick Pollock, Bart., P.C., as well as by many men well known in the electrical profession, either as members of the lodge or as visitors.

Reviews of Books, &c.

[Books noticed in this column will be sent from ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

WIRELESS FOR THE AMATEUR. By J. Roussel. (Constable, 14s. net.)—The many additions to literature on radio matters are in many cases unsuitable, as they do not fulfil any new requirements. Some are theoretical, others, while being practical, cover very much ground previously known, and it is unusual to find just that happy combination of theory and practice that provides useful and instructive information to the average wireless amateur.

We reviewed the French edition of Mr. Roussel's book, and at the time we were struck with its value. Not only has the book been very ably translated by Mr. H. B. Grylls, but the additions that have been made very considerably add to its value. The added matter covers information on short-wave reception and amplification, together with a chapter on C.W. transmission and telephony working on the wave-lengths allowed to amateurs. This has been necessary because Mr. Roussel's original work dealt, as far as Radio frequency amplification is concerned, with only resistance capacity coupling.

Beginning with a rapid historical survey, the reader is introduced to a simple receiver, and the more complicated apparatus is introduced step by step. Firstly, to obtain better tuning, then to amplify the received signals, and finally in automatically recording the incoming messages.

From the practical standpoint, the book is filled with interesting details, and as the author states that all the practical arrangements have been extensively used, there can be no doubt of their value.

The chapters on the Morse code, call letters, time signals, etc., are more important and instructive than the titles would lead one to believe, as they contain suggestions and ideas beyond those usually given under these headings.

To those amateurs whose workshop knowledge and experience is small, the chapter on materials and tools would enable them to proceed with their set building in the best possible way. Much information is condensed in a few pages devoted to the subject.

The simpler mathematics of wireless telegraphy are given in order that the book may be used for reference when it is desired to make any calculations necessary for home construction on a really scientific basis, oscillating electric phenomena are chiefly dealt with. The wave meter, its practical design and use, are briefly gone into, together with simple methods of measurement in the electric circuits.

We make no apology for giving the above brief outlines of some of the chapters of the book, although it must not be supposed that they in any way cover its scope.

The added chapters on short-wave receivers and short-wave transmitters are very well written, and contain very sound information.

Throughout the book the diagrams are clear and ample to the text, and space is not taken up with illustrations that have no bearing upon the scope of the information conveyed, a fault only too common in wireless literature.

In conclusion, it is the book that we should strongly recommend to all those who wish to go a little deeper into wireless matters than the average listener-in, as no other book we know of contains such a wealth of practical advice and information.

Trade Notes.

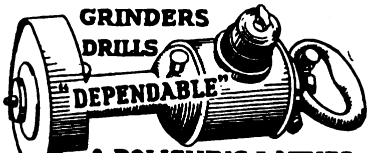
Heat Treatment Bulletin No. 31 has been issued by **Automatic and Electric Furnaces, Ltd.**, of 175, Farringdon Road, London, E.C.1. Its title is "Some Considerations of the Selection of Material and Heat Treatment for Tools," by A. R. Page, and is an interesting brochure on a subject of direct importance to all users of high-quality tool steel.

Messrs. W. T. Glover and Co., Ltd., Trafford Park, Manchester, have appointed, as their representatives for the Liverpool district, Messrs. J. H. Collie and Co., Ltd., 8, Harrington Street, Liverpool (Tel. No., 5039 Central), at which address they will maintain a stock of rubber insulated wires, cables and flexible cords.

Messrs. Jordan and Sons, Ltd., the well-known Company Registration Agents, 116, Chancery Lane, London, W.C.2, have just issued their annual statistical report, relating to new companies registered in England during 1923. They will be pleased to send a copy to any reader on application.

We have received from **B.D.S. Wireless, Ltd.**, 124 Devonshire Street, Birmingham, a copy of their latest trade catalogue of the Muzzullphone Crystal Sets in various types, as well as their amplifiers, condensers, inter-valve transformers, components, etc., all of which should be of direct interest to trade dealers in wireless sets and accessories. It will be willingly sent to trade readers.

A catalogue of "Osrecco" portable insulation testing sets has just recently been issued by **Messrs. Oswald Record and Co.**, the well-known electrical and mechanical engineers, of 17, Victoria Street, London, S.W.1. It gives illustrations and full particulars of this very efficient testing set, as well as of their pocket Wheatstone bridge, lightning-conductor bridge, etc., and should therefore appeal to all central station and testing engineers.



& POLISHING LATHES
MARRYAT & PLACE, ENGINEERS.
28 HATTON GARDEN, E.C.1.

Sample Pair Sent on Approval for 8/6

Made of Pure Para Rubber soft and durable and unaffected by climatic conditions
DAVID MOSELEY & SONS.
Limited.
ARDWICK. MANCHESTER.

MOSELEY
RUBBER GLOVES

R. & S. BAXTER & Co., LTD.,
Offices : 81, Murraygate, DUNDEE.
Works : Commercial Court.

MICA.

Importers and Manufacturers of
MICA FOR ALL PURPOSES.
Regular Shipments of Ruby, Clear, and Spotted Mica received at our stores at Dundee. Large Stocks always on hand.

Tele. Address : "FARINA, DUNDEE." Telephone: No. 88.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
A PRACTICAL TRADE JOURNAL

FEBRUARY 15, 1924.

CONTENTS.

	PAGE
Eddy Currents and their Avoidance	79
Institutional Engineering	80
Inventions and Industries	80
Electrification of the French Midi Railway	81
Current Topics	85
Questions and Answers by Practical Men	87
A.J.S. Wireless Receiving Sets	88
Problems in Telephony, Solved and Unsolved	88
Reviews of Books	89
" The Electrolunalytic's Alphabet "	91
Various Items	91
National Increase of Wages	92
Trade Notes	92

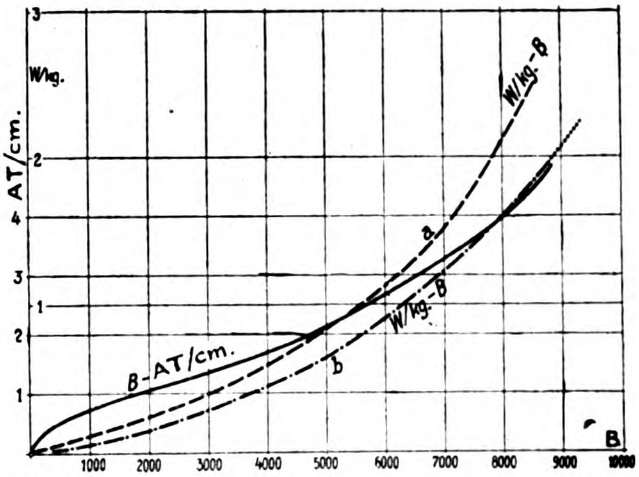
EDDY CURRENTS AND THEIR AVOIDANCE

The reduction of the light-load current is an important problem in the manufacture of every type of transformer, and the problem gains at once in importance and difficulty where very small transformers are concerned. Such transformers are now used in innumerable applications, amongst which may be mentioned measuring instrument circuits, bell ringing and the supply of small A.C. apparatus in general. The light load loss may reduce seriously the efficiency of the transformer, and in so far as it is not recorded by the meter, it may constitute a serious loss to the supply authority. The watt-component of the light-load current will be recorded if it is large enough to start the meter, but the wattless component will not be recorded, although it helps to lower the power factor of the whole installation and reduces the effective current carrying capacity of the mains and of the windings of the transformer itself.

We are here concerned, however, with the actual energy absorbed on light-load. Where butt joints are employed in the core they are commonly left as assembled (*i e.*, not filed or ground) for fear of increasing the eddy current loss by short-circuiting the laminations with particles of metal. Though this danger be averted, the magnetic resistance of the relatively rough joint is high and, as a way out of the dilemma, ring cores are often employed. These, unfortunately, add to the cost of manufacture by necessitating the threading of the winding turn by turn; a former wound coil cannot be got on to a ring core.

Such, hitherto, has been the position, but Dr. H. Kruzner suggests, in *Elektrotechnik u. Maschinenbau*, that filed or ground butt joints can be used without seriously increasing the eddy current loss, provided that the joints be etched with acid to remove the short-circuiting particles. There are grounds for supposing that this simple process may be applicable in practice, as witness the following test results :—

(1) Twenty pieces of transformer sheet, each 40 by 40 mm. and covered on one side with paper, were clamped together, and the resistance between the first and last plate, as measured by Wheatstone bridge, was found to be 60 ohms. The edge of the bundle was then filed (cross-wise, so as to produce maximum short-circuiting), whereupon the resistance between the faces fell to 0.2 ohm. The filed surface was then etched with dilute sulphuric and nitric acid, dried in a small gas flame and cleaned with an oily rag. After about 24 hours the resistance was measured again and found to be 30 ohms, *i.e.*, half the initial value; while the smooth end of the bundle was capable of making a much better magnetic joint than could have been made before filing. On opening out the plates the only sign of damage was a slight oxidation on a very narrow strip adjoining the etched edge.



(2) The magnetisation curve and watts-loss curve for an old single-phase transformer core (window opening 90 by 160 mm., iron section 50 by 50 mm., riveted without insulation) were taken before and after etching the two-butt joints. The magnetisation curve, ampere-turns per cm. against magnetic flux density B, was the same in both cases (see Fig.); but the watts loss per kg. was materially less after etching, drying and cleaning (curve *b*) than before this treatment (curve *a*).

The etching process has not yet been tried on a commercial scale, but its possibilities are apparently well-worth further investigation. Even if the method proves to have no application in mass production, it is a simple expedient which may be very useful in the jobbing workshop. Only the edges of the laminations should be treated and, needless to say, no trace of acid must be left on or in the core.

Meetings.—The Junior Inst.E. will meet on Friday, 15th inst. Lecture: "Some Suggestions for Road Transport Development," by Prof. D. S. Capper, M.A. (slides). And on Friday, 22nd inst. Lecturette: "Ciment Fondu: Its Manufacture and Special Uses," by J. S. Marshall. All at 39, Victoria St., at 7.30 p.m. On Saturday, 23rd inst., at 2 o'clock, there will be a visit to the British Empire Exhibition constructing at Wembley, to inspect the Railway of Never-Stop Transit, Ltd., in course of erection.——The I.E.E. will hold a joint meeting with the Physical Society of London in the lecture theatre of the I.E.E. on Thursday, 14th inst., at six p.m. Continuation of discussion on "Loud-Speakers for Wireless and Other Purposes."——The B'ham and District Electric Club will meet at the Grand Hotel, Colmore Row, on Friday, February 22, at 7 p.m., when Mr. H. Humphries will deliver a lecture on Automatic Telephony, illustrated by lantern slides and working equipment.

INSTITUTIONAL ENGINEERING.

Mr. W. Shaw adopted this title as the subject of his presidential address before the members of the Birmingham and District Electric Club on Friday, January 25, when he dealt with the wide range covered by engineering work required in hospitals and similar institutions, including the work of the civil engineer and surveyor, sanitary engineer, mechanical engineer, laundry engineer, heating engineer, gas engineer and electrical engineer.

In determining the details of plant Mr. Shaw gave as his opinion that engineers in general are apt to give so much thought to developing higher efficiencies, that in some cases sight is lost of the real ultimate aim – high economy. It is possible to have high efficiency with low economy, and high economy with low efficiency, and the former is undesirable.

For an institution of size steam offered great advantages, but it also entailed more sources of possible waste and loss than all the other losses of power production added together.

With regard to electric cooking, he stated that electrical apparatus is being substituted for gas and coal-heated ovens and ranges, and he gave particulars of a typical example, as follows:—

At a hospital the number of people catered for 500
(This includes the staff and patients.)
First cost of the equipment, excluding installation and erection £535
Maximum current consumption for the whole equipment ... ... 118 kw.
The equipment includes:—
Two three-oven ranges for roasting.
One steaming oven.
One fish fryer.
Two hot-plate cupboards.
Two special egg poachers, etc
One 20-gallon soup boiler for stock pot
Two 20-gallon vegetable boilers.
Three 20-gallon water boilers.
Average cooking hours per day, 3 to 3½ hours.
Average daily consumption, 120 to 145 units.
Cost per unit, 1½d.
Daily running costs—15s. to 18s. 6d. per day

Taking 450 persons as the average, and this is really on the low side, the cost per person per day works out between 0.4 to 0.48 pence. The only remark one would like to add in this case is that the cooking is rather more elaborate than would be the case in an ordinary industrial installation, because there is apt to be a large variety of dishes, etc., to suit special patients.

Dealing with lighting, Mr. Shaw stated that electricity, owing to its convenience, cleanliness and low maintenance cost, had now practically superseded gas for lighting in most institutions, but he confessed that in some instances, especially in hospitals, the schemes adopted were not the most suitable for their purpose, and in this connection he quoted the observation of Miss Florence Nightingale, "The very first requirement in a hospital is that it should do the sick no harm."

Gold Medal.—Messrs. Griffiths Bros. and Co., London, Ltd., have been awarded the gold medal for their insulating varnishes at the exhibition which was held in Brazil in 1923.

INVENTIONS AND INDUSTRIES.

At the annual general meeting of the Inst. of Heating and Ventilating Engineers, held on Feb. 11, Sir George Croydon Marks, M.P., delivered an address on this subject, in the course of which he referred to the misconception in the popular mind as to what constituted invention, as against what was described as discovery, and to the strange confusion of ideas regarding the protection of inventions by Letters Patent.

"Discovery" might be defined as the bringing to light what was already existent, but concealed or hidden from view, and therefore unappreciated by the ordinary observer, not the bringing into existence of something which, but for the investigator's discovery, would never have existed; thus—Newton, Harvey, Faraday and others did not invent, but discovered. On the other hand, "invention" was concerned with originating or producing something which did not previously exist, or doing in an improved way something which had previously been done otherwise, thus: Bessemer invented the process by means of which sulphur was removed from steel; Watt invented something which permitted steam to be economically used in an engine; Edison invented a filament which under the influence of an electric current, and when enclosed in a vacuum chamber, or globe, emitted light, and so on.

All industries of national importance were originally based on invention, and the countries which had been the most alert and active in encouraging invention were to-day those of the greatest importance in the industrial world.

The speaker then referred to the misapprehension in the popular mind as to the reason for the grant of a patent by the State, and stated that what the State sought was the development of new industries, or the improvement of its industrial resources, based upon that which the inventor had originated and produced, in other words, it was something in the nature of a bargain or contract between the State and the individual, by which the latter surrenders the prospective sole enjoyment of his invention for a State protected limited period of monopoly. By this the State secured for the nation the free use of the invention at the end of the patent period, and gave the nation the benefit of the improvement, or the new industry, which, but for the inventor, would not have had existence.

Finally, he warned his hearers against the astounding and revolutionary proposal lately before the League of Nations, relating to inventions, which, if proceeded with, would have a disastrous effect on industries depending on the development of scientific knowledge, as it proposed protection for the lifetime of the discoverer and fifty years afterwards.

Ideal Home Exhibition.—This always interesting exhibition is due to be opened by H.R.H. Duchess of York on the 28th inst. We understand that it will be more comprehensive than ever, and that domestic electrical appliances are to hold a very prominent position in every direction.

Tenders Accepted.—The Vickers-Spearing Boiler Co., Ltd., of 20, Kingsway W.C.2, have obtained the contract for two 30,000 lb. Spearing type boilers and complete equipment for the Maidstone Corporation.——The tenders of the Edison Swan Elec. Co., Ltd., have been accepted by the G.P.O. for resistance tablets, and by Lamport and Holt for six months' supplies of electrical lamps and material.

ELECTRIFICATION OF THE FRENCH MIDI RAILWAY.*

By A. BACHELLERY, Ingénieur-en-Chef, Chemins de Fer du Midi, France.

(*Continued from page* 65.)

Current is actually produced in the two hydro-electric stations at Soulom and Eget, the first equipped with 21,000 and the second with 35,000 horse-power, this last from a fall 2,300 feet high.

In addition to this, the Midi Company is building on the Gave d'Ossau three new power stations equipped for 130,000 horse-power with falls ranging from 600 to 2,500 ft. Other power plants are designed in the central and eastern Pyrenees for the time when electrification reaches those districts.

The current produced by all these plants is three-phase, 50 cycles, at 60,000 volts. It is transmitted by feeders following the railway, and in addition part of it is transformed to 150,000 volts for long-distance transmission. Lines for this purpose are already constructed as far as Bordeaux and Toulouse. Their total length is actually 420 miles, and the longest distance between step-up and step-down transformers is 175 miles.

These lines have been given a larger capacity than required by the needs of the railway. They are, in fact, meant to transmit, not only for traction, but also for distribution purposes, energy produced by numerous power plants all working in parallel. This transmission over lines belonging to the railway will be subject to taxes which will cover part of the expense.

Each line, designed to carry from 30,000 to 50,000 kw., consists of three copper cables each of 283,000 circular mils section. A steel earth wire is provided for protection.

The cables are suspended by insulator chains of 9 plate-type elements from steel towers 66 feet high and normally 660 ft. apart. Two of these lines, entirely independent of each other, join the Pyrenees to Bordeaux.

Transformation from 60,000 to 150,000 volts, and vice versa, is carried out in two step-up stations, equipped for 60,000 kw., and in three step-down stations equipped for 80,000 kw. The latter are provided with synchronous condensers of 60,000 kva. total capacity. All these stations are of the outdoor type.

Energy for traction is distributed along the railway by 60,000-volt feeders issuing either directly from the power plants or from the transformer stations. They are generally fixed to the same supports as the contact line. They consist of three 200,000 circular mil copper cables or aluminium equivalents.

Substations for converting three-phase current into direct current are built at distances varying from 8 to 20 miles, the drop in the line voltage not exceeding 20 per cent. under normal service.

Different types of converting apparatus have been used. Besides the classical groups of two 750-volt rotary converters connected in series, some substations have 1,500-volt 750-kw. rotary converters as single units. These are, the author believes, the first machines of this type wound for 50 cycles and they have been entirely successful. They can withstand 200 per cent. overload during 5 minutes, without flashing over.

The newest feature, however, is the use in some substations of mercury rectifiers producing 1,500-volt direct current. Five substations have been equipped in this way, containing, in all, 16 groups, each of 1,200 kw. Each group consists of a pair of cylinders connected in parallel, and fed with 12-phase current produced by special transformers.

The efficiency of these machines is very high, and practically independent of the load. Their overload capacity is equal to that of the rotary converters. Being static machines, they require very little attendance. So far no difficulty in keeping the vacuum in the cylinders has been experienced. The current they generate, although slightly undulating, is well withstood by the traction motors.

All substations possess high-speed circuit breakers on each group. In most of them, such high-tension apparatus as transformers and oil switches is placed out of doors.

The line equipment is of the double-catenary type. It consists of a steel messenger cable, of an auxiliary messenger, and of a contact wire, both of these made of 4/0 S.W.G. grooved copper. The auxiliary messenger is suspended from the main messenger by flat steel hangers 30 ft. apart on the straight and 15 ft apart on curves. The contact wire is fixed to the auxiliary messenger by clamps maintaining the two wires in a vertical plane.

On curves the catenary system is similar to that adopted on the Pennsylvania Railway. The line has no pull-offs, and follows the same curve as the track, the hangers taking an inclined position. This disposition gives a very smooth and uniform contact, and has the advantage of being self-compensating when the temperature varies.

On straight sections pull-offs are generally used on the auxiliary messenger. Elastic pull-offs, consisting of two helical springs disposed V-wise, have been applied with success. On some sections, however, as an experiment the pull-offs have been suppressed. In this case, the line is designed as a succession of curves staggered alternately 10 in. on either side of the middle of the track, and its tension is sufficient to prevent swinging. Up to now, this seems to give satisfaction.

The distance between supports varies from 300 ft. on straight sections to 150 ft. on curves under 2,600 ft. radius.

Different kinds of supports have been tried. On single track, the bracket type is generally used. There are also types of bracket construction for double track, with either steel or concrete poles. The last type adopted for double track is a cross-span construction consisting of two steel I beams assembled in the shape of a pointed arch. On these supports are fixed the 60,000-volt three-phase distribution line, the 1,500-volt direct-current feeders and catenary line, and in addition, in some cases, a 10,000-volt three-phase line for auxiliary and signal service.

Chain insulators are used for the high-tension line, as far as is allowed by clearance considerations. For the direct-current lines, double insulation is the rule, either by means of rigid or suspended insulators, the latter type being preferred.

Protection of transmission and contact lines against excess of current or voltage has been especially cared for. The high-tension lines are protected by selective relays and oil switches so disposed as to cut out automatically any section where a breakdown occurs. The system is, moreover, earthed at one of the power houses at the neutral point of a transformer. It is protected against pressure-rises by earthed reactance coils with iron cores, and against steep-front surges by Capart apparatus consisting of mica condensers branched between two inductive coils, one of which is shunted by a resistance.

---

* Paper read before the I.E.E. on November 22, 1923

Direct-current machines in the substations are protected, in addition to the oil switches and quick-acting circuit breakers, by inductive coils, and by an earthing device composed of a condenser shunted by a resistance.

Track bonding has been the object of a long discussion on the part of the Midi Company, who, having experimented with a great many different types of bonds, have not yet found any entirely satisfactory, the best, in their opinion, consisting of a pair of short copper bonds, made either of cable or packed strips, connecting each end of the fish-plate with the corresponding rail. The fixing is obtained by through bolts or by split steel rings forced into the rail holes.

The different lines to be electrified present very diverse features, including level main lines carrying fast passenger and heavy goods trains, branch lines to watering places where traffic assumes a partly suburban character, and mountain lines with exceedingly steep grades requiring very powerful locomotives. Nevertheless, they have succeeded in limiting the number of different types of locomotives to four. These types have been studied jointly by the company's officials and by the makers, namely, the Société des Constructions Electriques de France, which is associated with the English Electric Company.

The first electrical equipments were made in this last-mentioned company's works at Preston, and the succeeding ones in the Lyons works of the Société des Constructions Electriques de France.

The locomotives are built in extensive shops especially built by the latter at Tarbes, in the middle of our electrified system.

The first two types of engines are a passenger and a freight locomotive similar to one another except for the gear ratio. They are mounted on two 4-wheel motor trucks. Each of the four axles is driven by a geared nose-suspended motor.

These motors, of Dick Kerr design, with 4 poles and commutating poles, are wound for 1,500 volts. Under forced ventilation, their one-hour rating is 350 and their continuous rating 250 h.p. The total weight of the locomotive is 72 tons; and the speed limits are 55 miles per hour for the passenger engine and 40 miles per hour for the freight engine. The motor control is the Dick Kerr cam-shaft multiple-unit system. Different speeds are obtained through series-parallel and field-shunting combinations.

Low-tension current for auxiliary service is produced by a 72 kw. group. This includes, mounted on the same shaft, a 1,500-volt motor, two direct-current generators and two fans for ventilating the traction motors. One of the generators produces 120-volt current for the control circuits, for lighting the train, and for feeding the air compressor. The second one is a variable-pressure dynamo used for exciting the motor fields when regenerative braking is in action.

Owing to this arrangement the locomotive has but one auxiliary 1,500-volt motor, which is an advantage, this being, as is well known, the delicate part of high-tension direct-current equipments.

The coupling devices and buffers are fixed to the truck frames, and these are themselves coupled together by a double drawbar and lateral buffers, so that the tractive effort is not in any way transmitted by the centre pins.

The cab suspension is so designed as to leave the highest degree of freedom to the trucks. The contact surface between centre plate and pivot has its concavity turned downwards and its centre near the axle plane; this eliminates reactions when the bogie pitches in any direction. To prevent the cab tilting, lateral springs suspended by swinging rods are interposed between the cab and the truck frames. This device is preferable to the ordinary support blocks, in that it allows perfectly free horizontal displacement. No equalisation of the truck suspension has been found necessary.

Each motor drives its axle by two symmetrical gears. In order to avoid axle breaking, which has given a great deal of trouble on the first electrified lines, each gear wheel, instead of being mounted on the axle, consists of a cogged rim bolted on to the truck wheel-centre.

The locomotive is equipped with both the Westinghouse automatic air brake and a straight air brake. Compressed air is provided by a Westinghouse gearless air compressor. In addition to these, an electric brake is provided. For the first machines, this is based on the regenerative principle, the current generated by the motors being sent into the trolley line. In this case the motors are separately excited by an auxiliary generator, and speed regulation is obtained by varying this generator's excitation.

Experience has shown that the saving of energy resulting from regenerative braking is comparatively small, and does not justify the complication it introduces into the locomotive's equipment. It has therefore been abandoned for the future, and rheostatic braking adopted in its place.

Whatever the system, electric braking is to be used for going down long grades, so as to save the wear of brake shoes. It is accordingly designed so as to hold the load which the engine is able to haul up the same gradient.

The current-collecting apparatus has been designed with special care, in order to obtain a smooth contact and to avoid sparking. It consists of a pantagraph fitted with ball bearings at each joint. The collector is made of two steel pans lined with copper strips and borne on helical springs. By these means, the greatest flexibility has been realised and good collection obtained at all speeds.

(*To be continued.*)

Finance.—The annual report of the Northampton E.L. and P. Co., Ltd., shows a steady expansion in business. The directors propose a final dividend equivalent to 9 per cent. per annum, carrying forward over £8,000.——The annual report of the Rushden and District E.S. Co., Ltd., is also a satisfactory document, the dividend paid being equivalent to 8 per cent. per annum, with a carry forward of nearly £3,000.

Meetings.—The Illuminating Engineering Society will meet at the Royal Society of Arts (John Street, Adelphi, London), at 8 p.m. on Tuesday, 19th inst. Discussion on "Some Aspects of Railway Lighting" to be opened by Mr. J. F. Caine and Mr. E. A. Marx.——A students' meeting of the I.E.E. will be held on Friday, 15th inst., at 6.30 p.m., when Mr. T. J. Barfield will read a paper on "E.H.T. Switchgear."

Don't worry! THERE IS A
BENJAMIN
REFLECTOR
for
EVERY CLASS of
LIGHTING
INSTALLATION.

Advert. of the Benjamin Electric Ltd., Brantwood Works, Tariff Road, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and Abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Tuesday morning, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

Abolish Strap-hanging.

It is reported that a very laudable effort is to be made to prevent railway companies continuing to carry strap-hangers, or, in other words, encourage unlimited overcrowding of their passenger rolling-stock. The announcement was made by Mr. A. H. Garstang, Secretary of the National Association of Railway Travellers. According to Mr. Garstang, "the number of cattle carried in each truck is regulated, and at least passengers are entitled to the same consideration." The law provided that railway companies could be fined for every person carried in excess of the number allowed. It is to be hoped that this well-intentioned campaign for more humane and healthful transport on our railways will achieve success; but why stop at railways? Some of the worst cases of overcrowding in the country occur in connection with tramways, and there it is not a case of strap-hanging, because the evil is so rampant that, although a modicum of straps are provided, there are not nearly enough to go round when the licensed overcrowding is at its height.

I have long preached the gospel of hygienic and comfortable travel conditions on our railways and tramways. There is no logical excuse for packing upwards of one hundred human beings into a space normally intended to seat about half that number. Unfortuately, the public are largely to blame for the present state of affairs; in their eagerness to travel they will enter vehicles and railway carriages which are already crowded to suffocation, and endure stoically the acute discomfort of such totally unhealthy and dangerous conditions day after day without complaining publicly, although they grumble among themselves. So long as the general public put up with these abnormal conditions, the railway and other passenger transport bodies, whether company or municipal, will naturally take advantage of the fact, because every additional passenger who can be packed into an already overloaded vehicle helps to bring down the cost per car-mile of the particular service involved.

Started largely as a war-time measure, and since encouraged by officialdom, overcrowded travel has become an accepted condition of our everyday lives, and, if nobody intervenes, we shall probably go on travelling more and more *à la sardine* until we hand in our checks at the cemetery gates. And there is absolutely no necessity for such a state of things. Railway coaches were designed for the accommodation of so many passengers (seated) per compartment, tramcars and 'buses the same. The various systems cannot all have been working at a loss when they used to carry the normal number of passengers, or they would have gone out of existence long before the war. The man who said no tramway service could be made to pay unless overcrowding were permitted did not know his business. All our present transport systems started on the basis of a strictly regulated passenger load, and it is only custom and the easy tolerance of a long-suffering public which has brought about the present condition of things. So flagrant is the abuse of space nowadays that quite elaborate " straps " have come to be regarded as standard fittings in modern tube coaches and other public vehicles.

If the public will not insist on their legitimate privileges, viz., a seat and reasonable space and air when travelling, it is up to the responsible Government authority to see that they get it in spite of themselves. I am not sure, but I should imagine this is a matter for the Ministry of Transport, and it is possible that Mr. Garstang's association proposes approaching that body with a view to much needed reform. I anticipate that the movement will meet with no considerable opposition on the part of the transport interests concerned, because their present tactics savour of profiteering in that they are carrying the maximum human freight in the minimum space whenever and wherever possible, thereby sqeezing the utmost farthing of profit out of the very considerable enterprise of transporting the public from place to place. In actual fact, we travel far too much and we do not walk enough. The frequency and facility of passenger transport nowadays tempts everybody to hop on to a tram, 'bus or tube, even if they have only a quarter of a mile or so to cover. Although time is very frequently an object, it is not invariably more valuable than the added health which comes from walking exercise. I personally walk from five to six miles daily, in connection with my business, and quite irrespective of weather conditions. There are trams which I could use were I so minded, but the service is, as usual, so hopelessly overcrowded that I find it healthier and more comfortable to fall back upon shanks's pony, and there must be thousands of others who could well afford the time to do likewise.

Waste.

A very powerful argument in favour of the abolition of the old-fashioned domestic grate and the substitution of modern electric heating and cooking was advanced by Mr. J. A. Priestley, superintendent of the Sheffield Cleansing Department, in a recent lecture. He pointed out that the mere collection of house refuse provided, in England and Wales alone, employment for relays and oil switches so disposed as to cut out automatically any section where a breakdown occurs. The system is, moreover, earthed at one of the power houses at the neutral point of a transformer. It is protected against pressure-rises by earthed reactance coils with iron cores, and against steep-front surges by Capart apparatus consisting of mica condensers branched between two inductive coils, one of which is shunted by a resistance.

Direct-current machines in the substations are protected, in addition to the oil switches and quick-acting circuit breakers, by inductive coils, and by an earthing device composed of a condenser shunted by a resistance.

Track bonding has been the object of a long discussion on the part of the Midi Company, who, having experimented with a great many different types of bonds, have not yet found any entirely satisfactory, the best, in their opinion, consisting of a pair of short copper bonds, made either of cable or packed strips, connecting each end of the fish-plate with the corresponding rail. The fixing is obtained by through bolts or by split steel rings forced into the rail holes.

The different lines to be electrified present very diverse features, including level main lines carrying fast passenger and heavy goods trains, branch lines to watering places where traffic assumes a partly suburban character, and mountain lines with exceedingly steep grades requiring very powerful locomotives. Nevertheless, they have succeeded in limiting the number of different types of locomotives to four. These types have been studied jointly by the company's officials and by the makers, namely, the Société des Constructions Electriques de France, which is associated with the English Electric Company.

The first electrical equipments were made in this last-mentioned company's works at Preston, and the succeeding ones in the Lyons works of the Société des Constructions Electriques de France.

The locomotives are built in extensive shops especially built by the latter at Tarbes, in the middle of our electrified system.

The first two types of engines are a passenger and a freight locomotive similar to one another except for the gear ratio. They are mounted on two 4-wheel motor trucks. Each of the four axles is driven by a geared nose-suspended motor.

These motors, of Dick Kerr design, with 4 poles and commutating poles, are wound for 1,500 volts. Under forced ventilation, their one-hour rating is 350 and their continuous rating 250 h.p. The total weight of the locomotive is 72 tons; and the speed limits are 55 miles per hour for the passenger engine and 40 miles per hour for the freight engine. The motor control is the Dick Kerr cam-shaft multiple-unit system. Different speeds are obtained through series-parallel and field-shunting combinations.

Low-tension current for auxiliary service is produced by a 72 kw. group. This includes, mounted on the same shaft, a 1,500-volt motor, two direct-current generators and two fans for ventilating the traction motors. One of the generators produces 120-volt current for the control circuits, for lighting the train, and for feeding the air compressor. The second one is a variable-pressure dynamo used for exciting the motor fields when regenerative braking is in action.

Owing to this arrangement the locomotive has but one auxiliary 1,500-volt motor, which is an advantage, this being, as is well known, the delicate part of high-tension direct-current equipments.

The coupling devices and buffers are fixed to the truck frames, and these are themselves coupled together by a double drawbar and lateral buffers, so that the tractive effort is not in any way transmitted by the centre pins.

The cab suspension is so designed as to leave the highest degree of freedom to the trucks. The contact surface between centre plate and pivot has its concavity turned downwards and its centre near the axle plane; this eliminates reactions when the bogie pitches in any direction. To prevent the cab tilting, lateral springs suspended by swinging rods are interposed between the cab and the truck frames. This device is preferable to the ordinary support blocks, in that it allows perfectly free horizontal displacement. No equalisation of the truck suspension has been found necessary.

Each motor drives its axle by two symmetrical gears. In order to avoid axle breaking, which has given a great deal of trouble on the first electrified lines, each gear wheel, instead of being mounted on the axle, consists of a cogged rim bolted on to the truck wheel-centre.

The locomotive is equipped with both the Westinghouse automatic air brake and a straight air brake. Compressed air is provided by a Westinghouse gearless air compressor. In addition to these, an electric brake is provided. For the first machines, this is based on the regenerative principle, the current generated by the motors being sent into the trolley line. In this case the motors are separately excited by an auxiliary generator, and speed regulation is obtained by varying this generator's excitation.

Experience has shown that the saving of energy resulting from regenerative braking is comparatively small, and does not justify the complication it introduces into the locomotive's equipment. It has therefore been abandoned for the future, and rheostatic braking adopted in its place.

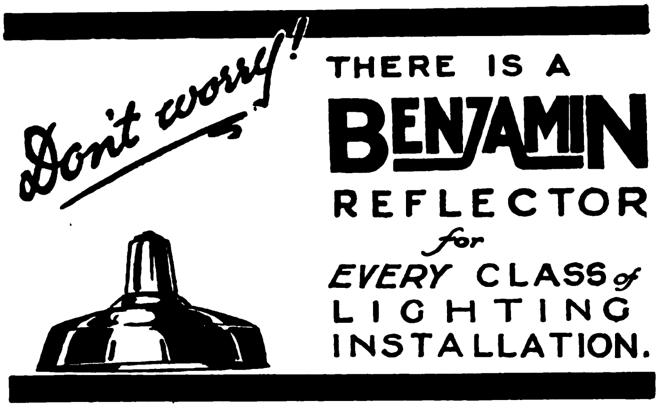
Whatever the system, electric braking is to be used for going down long grades, so as to save the wear of brake shoes. It is accordingly designed so as to hold the load which the engine is able to haul up the same gradient.

The current-collecting apparatus has been designed with special care, in order to obtain a smooth contact and to avoid sparking. It consists of a pantagraph fitted with ball bearings at each joint. The collector is made of two steel pans lined with copper strips and borne on helical springs. By these means, the greatest flexibility has been realised and good collection obtained at all speeds.

(*To be continued.*)

Finance.—The annual report of the Northampton E.L. and P. Co., Ltd., shows a steady expansion in business. The directors propose a final dividend equivalent to 9 per cent. per annum, carrying forward over £8,000.——The annual report of the Rushden and District E.S. Co., Ltd., is also a satisfactory document, the dividend paid being equivalent to 8 per cent. per annum, with a carry forward of nearly £3,000.

Meetings.—The Illuminating Engineering Society will meet at the Royal Society of Arts (John Street, Adelphi, London), at 8 p.m. on Tuesday, 19th inst. Discussion on "Some Aspects of Railway Lighting" to be opened by Mr. J. F. Caine and Mr. E. A. Marx.——A students' meeting of the I.E.E. will be held on Friday, 15th inst., at 6.30 p.m., when Mr. T. J. Barfield will read a paper on "E.H.T. Switchgear."



THERE IS A BENJAMIN REFLECTOR for EVERY CLASS of LIGHTING INSTALLATION.

Advert. of the Benjamin Electric Ltd., Brantwood Works, Tariff Road, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and Abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Tuesday morning, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

Abolish Strap-hanging.

It is reported that a very laudable effort is to be made to prevent railway companies continuing to carry strap-hangers, or, in other words, encourage unlimited overcrowding of their passenger rolling-stock. The announcement was made by Mr. A. H. Garstang, Secretary of the National Association of Railway Travellers. According to Mr. Garstang, "the number of cattle carried in each truck is regulated, and at least passengers are entitled to the same consideration." The law provided that railway companies could be fined for every person carried in excess of the number allowed. It is to be hoped that this well-intentioned campaign for more humane and healthful transport on our railways will achieve success; but why stop at railways? Some of the worst cases of overcrowding in the country occur in connection with tramways, and there it is not a case of strap-hanging, because the evil is so rampant that, although a modicum of straps are provided, there are not nearly enough to go round when the licensed overcrowding is at its height.

I have long preached the gospel of hygienic and comfortable travel conditions on our railways and tramways. There is no logical excuse for packing upwards of one hundred human beings into a space normally intended to seat about half that number. Unfortunately, the public are largely to blame for the present state of affairs; in their eagerness to travel they will enter vehicles and railway carriages which are already crowded to suffocation, and endure stoically the acute discomfort of such totally unhealthy and dangerous conditions day after day without complaining publicly, although they grumble among themselves. So long as the general public put up with these abnormal conditions, the railway and other passenger transport bodies, whether company or municipal, will naturally take advantage of the fact, because every additional passenger who can be packed into an already overloaded vehicle helps to bring down the cost per car-mile of the particular service involved.

Started largely as a war-time measure, and since encouraged by officialdom, overcrowded travel has become an accepted condition of our everyday lives, and, if nobody intervenes, we shall probably go on travelling more and more *à la sardine* until we hand in our checks at the cemetery gates. And there is absolutely no necessity for such a state of things. Railway coaches were designed for the accommodation of so many passengers (seated) per compartment, tramcars and 'buses the same. The various systems cannot all have been working at a loss when they used to carry the normal number of passengers, or they would have gone out of existence long before the war. The man who said no tramway service could be made to pay unless overcrowding were permitted did not know his business. All our present transport systems started on the basis of a strictly regulated passenger load, and it is only custom and the easy tolerance of a long-suffering public which has brought about the present condition of things. So flagrant is the abuse of space nowadays that quite elaborate " straps " have come to be regarded as standard fittings in modern tube coaches and other public vehicles.

If the public will not insist on their legitimate privileges, viz., a seat and reasonable space and air when travelling, it is up to the responsible Government authority to see that they get it in spite of themselves. I am not sure, but I should imagine this is a matter for the Ministry of Transport, and it is possible that Mr. Garstang's association proposes approaching that body with a view to much needed reform. I anticipate that the movement will meet with no considerable opposition on the part of the transport interests concerned, because their present tactics savour of profiteering in that they are carrying the maximum human freight in the minimum space whenever and wherever possible, thereby squeezing the utmost farthing of profit out of the very considerable enterprise of transporting the public from place to place. In actual fact, we travel far too much and we do not walk enough. The frequency and facility of passenger transport nowadays tempts everybody to hop on to a tram, 'bus or tube, even if they have only a quarter of a mile or so to cover. Although time is very frequently an object, it is not invariably more valuable than the added health which comes from walking exercise. I personally walk from five to six miles daily, in connection with my business, and quite irrespective of weather conditions. There are trams which I could use were I so minded, but the service is, as usual, so hopelessly overcrowded that I find it healthier and more comfortable to fall back upon shanks's pony, and there must be thousands of others who could well afford the time to do likewise.

Waste.

A very powerful argument in favour of the abolition of the old-fashioned domestic grate and the substitution of modern electric heating and cooking was advanced by Mr. J. A. Priestley, superintendent of the Sheffield Cleansing Department, in a recent lecture. He pointed out that the mere collection of house refuse provided, in England and Wales alone, employment for

34,000 workmen, 8,000 horses and wagons, and 1,600 motors. The plant, buildings and equipment devoted to this purpose were estimated to have a capital value of £5,000,000. In a mining district the amount of refuse per house was as much as 300 per cent. higher than the normal. That was due to a large extent to the practice of supplying free coal to miners. The refuse in these districts consisted largely of unburnt fuel. In other words, what the community obtains for nothing it values accordingly, and wastes in due proportion.

The refuse collected in the slum areas of Sheffield was much larger in quantity than that collected in the better class areas. Where it was least desirable that there should be an accumulation of refuse they found it greatest. The refuse could be divided as follows:—Unburnt fuel 40 per cent., dust 40 per cent, tins 1½ per cent., paper 3 per cent., miscellaneous rubbish 15 per cent. "I think," said Mr. Priestley, "that it is a deplorable state of affairs that, notwithstanding the many requests that have been made from time to time, people will not themselves dispose of more of the refuse they produce. Nearly half the refuse we collect consists of fuel which could advantageously be burnt in the domestic grate."

What is true for Sheffield is doubtless equally true, in varying degree, for all other large cities and towns, so that in the aggregate a very considerable annual wastage of costly fuel goes on in this country. When one also takes into account the admittedly low efficiency of the domestic grate for heating and cooking requirements, it is only too obvious that instead of conserving our already heavily diminished coal resources we are still continuing to use them up in a thoroughly wasteful and inefficient manner. The sooner we bring about a wholesale conversion to electric heating and cooking in all our larger cities and centres of population the greater will be the economies effected. Coal burnt in modern steam-raising plant where every precaution known to science is taken to extract the last thermal unit from every ton of fuel consumed, represents the best known method of supplying the town dweller with light, heat and power, at the same time materially assisting towards an ultimate solution of the pressing problems of smoke and fog.

Women in Illuminating Engineering.

In their efforts to arouse interest in lighting problems, the Illuminating Engineering Society has always welcomed the participation of women, and I understand that, from the first, no distinction of sex has been made as regards membership. Domestic lighting is of primary interest to the lady of the house, and there are many other fields, such as the dressing and lighting of show windows (which should be considered conjointly), where the woman expert can do useful work. An instance was afforded by the meeting of the Women's Engineering Society on February 5, over which Mr. Leon Gaster presided. The introductory paper by Miss M. Partridge, on "Electricity as used for Publicity," showed a good knowledge of modern lighting problems, and led to an interesting discussion. All the latest forms of signs were described, and the nature of their appeal to the public analysed. Most of the speakers showed a recognition of the fact that novelty and pleasing appearance are to be desired, rather than violent flashing or excessive brightness; while, in regard to show-window lighting, the sound principles which the Society has advocated for so many years were fully endorsed.

Johannesburg Telephones.

I congratulate the members of the South African Institute of Electrical Engineers on the remarkably clear and well-illustrated paper on "Recent Developments in Automatic Telephony (with special reference to Johannesburg)," which was read on November 15 last by Mr. T. H. Watson, and has been reprinted in the December issue of the *Transactions* of that Institute. It is an excellent description of the latest progress in A.T.M. work as adopted here by the British Post Office, and shows how the Director system could be applied to Johannesburg and the Reef. I can but hope that it will materialise at an early date.

Telegraphy and the Typewriter.

I have just been reading, with keen interest, an article in the latest issue of the *Telegraph and Telephone Age*, of New York, describing the jubilee celebrations at Ilion, N.Y., on September 12 last, when a memorial was unveiled to Christopher Latham Sholes, who was the inventor of the first practical writing machine. Apparently it was a very well-arranged affair, to which full justice is given in the article, and towards the end of the text the writer describes the intimate association borne by men in the American telegraph service in assisting the writing machine to prove its value as an actual time-saver, and thereby to revolutionise the social order of the world. Two names stand prominently forward in this connection, viz., Mr. Charles E. Weller, a telegraph operator and shorthand writer, residing in Milwaukee in 1867, and Mr. E. Payson Porter, who in 1868 was a Western Union telegraph operator in Chicago, and astonished the inventor by the rapidity with which he operated the typewriter keys at first sight.

The result of the initial test was that at a further official demonstration made in 1869, under the supervision of high officials of the great Western Union Telegraph Co., Mr. Payson Porter was quite easily able to compete with and surpass "expert" senders from the operating room, with the result that the typewriter was taken into the operating room. This gives the whole gist of typewriting in its relation to telegraphy. It is simply in the superior speed of the machine over hand-writing in receiving over the wire, and it is just this difference in speed which in the past forty years has revolutionised the telegraphist's profession. That partnership is as firmly established to-day as the other between the typewriter and shorthand.

The typewriter and telephone were born at about the same time. They were both first brought prominently to the attention of the public at the Centennial Exposition in Philadelphia in 1876. Neither was there recognised as something that was to revolutionise business methods and open up new roads to success. But both, with humble beginnings, and in spite of early discouragement, have gone on their triumphant way, until to-day they are recognised as the two leading factors of the world's communication. Elektron.

Questions and Answers by Practical Men.

RULES.

QUESTIONS : *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS : *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

Commencing with Question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 177.

I am in charge of a large D.C. motor plant, and I wish to design a starter that will start, in case of emergency, any motor from 5 h.p. to 75 h.p. Can any reader give me some helpful suggestions which can be embodied in the design?—"TESTER."

QUESTION NO. 178.

When working a cinema projector on 200 volts 50 cycles, with a three-bladed shutter, an intermittent light was produced on the screen. By using a single-bladed shutter this was eliminated. Can any reader explain this to me?—"OPERATOR."

(*Replies to Questions Nos.* 177 *and* 178 *must be received not later than March* 29, 1924.]

Answers to Questions.

QUESTION NO. 171.

I have a 10 h.p. motor and the cone insulation on the vee rings has given out. How can I build this up again?—"A. C. WARNER."

REPLIES TO QUESTION NO. 171.

The first prize (10s.) has been awarded to "M. M." for the following reply :—

As it is almost certain that the rings are built up of mica, we will first consider how such rings may be made :—

In Fig. 1, *a b c d* is an elevation of a vee-ring; the sides *a c* and *b d* are produced to meet at *o*. From the centre *o*, with radius *oa*, describe the circle *a b e h*, and with radius *oc* describe the circle *c d f g*. Then if these circles are completed we have an annulus or circular ring. The required vee-ring could be built up from such annuli, but this would mean an extravagant use of mica. Suitable pieces, such as that shown chain-dotted, are cut from scrap mica. The actual size taken is not important, the angle *f o g* is usually about 90 deg.

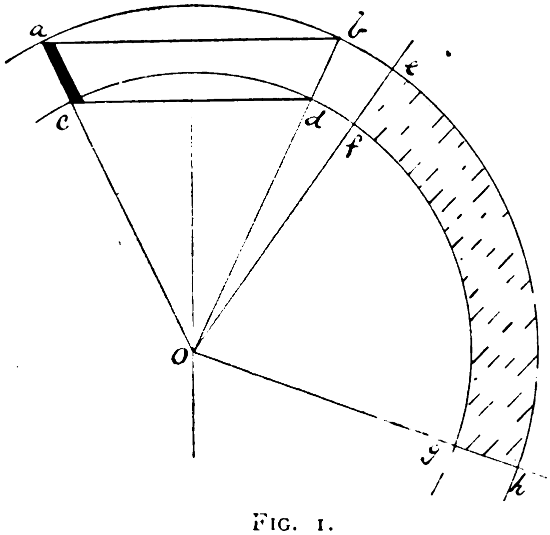


FIG. 1.

Having cut out a sufficient number of pieces of mica, they should be divided up in thin laminations; this will enable the operator to lay them together more easily. Build up the ring in a clamp as shown in Fig. 2. Note that in each figure the section of the vee-ring is shown black. *i* is a brass, or gunmetal, ring. If this ring has been divided into three or four pieces, these pieces may be readily removed when the vee-ring is built up to size. A small quantity of shellac will hold the pieces together during process of building. Take care to "break" the joints. Then gently place *k* in position and screw down by means of the bolt. Remove *k* and take out the brass ring *i*. Replace *k* and screw down. Heat up the whole combination sufficiently to soften the shellac and screw down firmly. When cold the vee-ring may be removed and will be found to be quite a solid article. Removal is facilitated if, before the first layer and after the last layer of mica, french chalk is dusted on to prevent mica sticking to the cast-iron clamp.

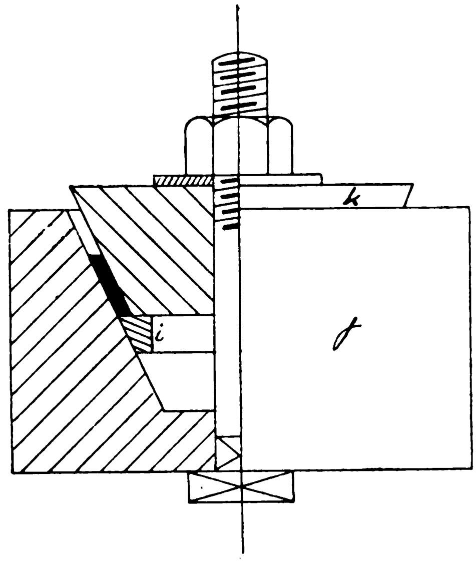


FIG. 2.

Vee-rings so made can be easily turned in the lathe to the exact dimensions required, they will be found firm enough to stand a considerable amount of manipulation.

If new rings can be purchased it will be certainly cheaper than making them.

Again, if they are made of other materials, such as vulcanised fibre, they may be turned to shape and size required.—"M. M."

The second prize (5s.) has been awarded to "G. F. S.," Birkenhead, for the following reply :—

If the cone insulation of V-ring is broken down near the edge of cramping ring, it can often be detected by passing a current through one or more lamps in parallel through cramping ring and commutator. Smoking and sparking will indicate position of fault. To clear same take a small knife, cut and scrape away charred mica, trying with lamp from time to time until short is cleared. Then prepare a stiff paste of dental plaster of Paris mixed with either shellac-varnish or dextrine in water. Fill in the recess with the mixture and level off. When dry the surface can be well shellac-varnished over. The addition of a layer of tape, over which a string binding has been bound and the whole well shellaced, is an advantage where width of cramping ring will allow.

To build up insulation where the above method cannot be employed proceed:—Clean up surface of commutator and wrap twice round in a central position a 1½ in. strip of presspahn or stout brown paper. Over this wind tightly several turns of, say, No. 18 copper or tinned steel s.w.g. wire. Anchor off end in a manner similar to an armature binding band and solder in places to secure. The former is to insulate the latter, which is to secure commutator segments when end cramping plate is removed. Now remove top cramping bush, take out mica cone by passing a thin knife blade at the back, scrape groove clean of all odd or charred pieces of mica, test round commutator between segments with lamps to see that none are shorted, then shellac-varnish commutator cone. Now examine old V-ring and cut out broken-down portion. Prepare the ends for half-lapping to new sector pieces by cutting down to half-thickness for the distance of ⅝ in., well varnish old ring and replace in groove of commutator. To make good space in old ring cut one or two sectors (Fig. 1) of brown paper and fit into cone groove; these should just occupy the space making a butt joint against ends of old ring. Having made by trial the above templates, cut from them in sheet micanite several sectors of about 1/16 in. thickness. Having obtained a wooden wedge (Fig. 2), shape to fit in the end of cone groove which is to be used for pushing sectors into position. Now place micanite sectors on a sheet-iron plate over a vessel containing boiling water. When softened, bend a sector over wedge and press into groove, making sure it butts up against old ring or previous sector. On each layer joint should come half-way over sector of last layer. Each layer is varnished and well pressed home with wedge until even thickness of ring is made up. The cramping ring can then be placed on the cone-ring, trimmed up and tape and string binding added if required, as in first method.—" G. F. S." (Birkenhead).

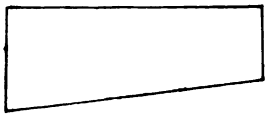


FIG 1

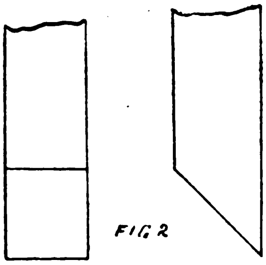


FIG 2

Abacas Engineering Co., Ltd., of 10, Canning Place, Liverpool, have issued leaflet P.B.1 dealing with their well-known electric pulley blocks, which represent a very useful machine for practical use in factories of all descriptions.

A.J.S. WIRELESS RECEIVING SETS.

We have received from Messrs. A. J. Stevens and Co. (1914), Ltd., of Graiseley House, Wolverhampton, a pamphlet dealing with A.J.S. two-, three- and four-valve receiving sets, and also the A.J.S. wireless book of instructions and information, price 6d.

The receiving sets are of the conventional desk type, in which the panel slopes back slightly from the vertical. The general layout is good and neat, and the apparatus is supplied complete with batteries, valves, etc., ready for erection. The makers claim that the latest improvements in reaction circuits used in the apparatus render the tuning very selective, and enable any broadcasting station to be tuned in as desired, in addition to which the operation is simple and easily carried out.

The sets are fitted with plugs and sockets to enable loading coils to be fitted to operate on the longer wave-lengths. The sets, as supplied, without loading coils, operate over a wave-band of approximately 300 to 500 metres. It is interesting to note that each valve has its own filament resistance, a very important point too seldom adopted by the builders of complete receiving sets.

The letters "A.J.S." are very widely known throughout motor-cycling circles, where they stand for quality, efficiency and service, and they are evidently out for the same opinion among listeners-in.

The small booklet, price 6d., contains quite a lot of valuable information, but it is, of course, written with a view to instructing purchasers of A.J.S. sets, to which the diagrams and information almost exclusively apply. The two pages of "Don'ts" are instructive. Some are amusing, and the last of importance, this being: "Don't forget the B.B.C. licence."

PROBLEMS IN TELEPHONY, SOLVED AND UNSOLVED.*

By PROFESSOR J. A. FLEMING, M.A., D.Sc., F.R.S.

(*Continued from page 76.*)

Similar coil-loaded cables were laid to Belgium in 1911 and under the Irish Channel in 1913 by the British Post Office. The difficulties involved in the construction, laying, and especially in the raising and repairing of such coil-loaded submarine cables, would be far too great in the case of deep-sea cables to render them practical, and hence much attention has been directed to the alternative method of loading called uniform loading, which was first practically employed in 1902 by the Danish Telephone Engineer C. E. Krarup in a telephone cable laid between Elsinore and Helsingborg.

The method consists in overwinding or whipping the copper conductor with one or two layers of soft iron wire put on in close turns. This increases the inductance of the core and also to some extent its capacity and effective resistance.

It is not found practicable to increase the layers of iron wire so as to give an added inductance per mile equal to that which can be obtained by coil loading, without passing the point of minimum attenuation constant, owing to the simultaneous increase of the capacity and resistance. A certain compromise can be effected by somewhat increasing the diameter of the stranded copper core as compared with that which would be employed if the cable were to be coil-loaded instead of uniformly loaded.

---

* Lecture delivered before the Institution of Electrical Engineers, to whom we are indebted for the illustrations.

In the case of uniformly loaded cables there is more difficulty in the predetermination of the resulting improvement in reduction of the attenuation constant by the loading, owing to the uncertainty which must exist as to the exact value to be ascribed to the magnetic permeability of the iron under the conditions in which it is used. When employing coil loading we can always make fairly exact measurements of the effective resistance and inductance of a sample loading coil, and if the cable is a double parallel-wire cable of known inductance, capacity and resistance per mile, we can then predict with very approximate accuracy the effect of loading at certain intervals the said cable with the measured type of coil. In the uniformly loaded cable we have in the iron wire spiral an imperfectly complete iron path for the lines of magnetic flux. The magnetising forces are weak, owing to the small value of the telephonic currents, and the frequency and force are constantly varying within wide limits. Nevertheless, experience has shown that if we ascribe to the iron a mean permeability of 110 or 115 the predicted inductance agrees fairly well with the measured values of that of the uniformly loaded cable. In addition to several short telephone cables of this type laid in North Sea waters prior to 1904, an Anglo-French cable was laid across the English Channel in 1912 by the French Government which was made and laid by the Telegraph Construction and Maintenance Company of London. This cable is a four-core cable, each core consisting of copper conductors weighing 300 lb. per naut. Each core is whipped with one layer of iron wire 0.012 inch in diameter, and four such whipped cores are made up into a double-circuit quad cable. The wire-to-wire capacity is 0.176 μF per naut of loop and at a frequency of 1,000 the attenuation is 0.018 per naut. In the case of the coil-loaded 1910 cable the attenuation at 1,000 p.p.s. is 0.020, but the copper core of the last-named cable only weighs 160 lb. per naut. Hence it is seen that by nearly doubling the section of copper core the iron wire single-layer whipping produces the same effect as the coil-loading as regards attenuation.

One of the latest examples of this type of uniformly loaded telephone cable is that laid in triplicate between Key West on the coast of Florida, U.S.A., and Havana, on the island of Cuba, a distance of 105 nautical miles (1 nautical mile=6,087 feet). Since the sea channel has a maximum depth of 1,000 fathoms in the Florida Straits, no type of cable except the standard deep-sea type with G.P. insulation was possible. Also it was decided that no type of coil-loaded cable was feasible. Neither was a multiple-circuit cable considered suitable. Hence the only practicable type was an armoured, uniformly loaded cable with a single copper core. In the case, however, of such a cable the return circuit is partly by sea and partly by the armour, and, as the distribution of the return current depends upon the frequency, this, in turn, affects the inductance. It was therefore decided to provide a definite return path by overwinding the insulated copper core with a triple spiral of thin copper tape. The cable was then armoured over this in the usual way. The final effect was to produce a concentric conductor with the central member whipped with fine iron wire 0.008 inch in diameter put on in 120 close turns per inch run. The copper core weighed 350 lb. to the naut and had a resistance of 3.52 ohms at 75° F.

The measured inductance at 1,000 p.p.s. was 4.35 mH and the capacity 0.31 μF per nautical mile.

The attenuation and resistance per naut increase rapidly with the frequency, as shown in the table below:—

Key West-Havana Submarine Uniformly Loaded Telephone Cable, 105 *Nauts*.*

Frequency, p.p.s.	Attenuation per naut.	Resistance, in ohms per naut	Transmission Equivalent, in M.S.C.
200	0.0168	4.1	19.8
500	0.0194	4.5	19.4
1,000	0.0216	4.8	20.8
2,000	0.0278	5.8	27.2
3,000	0.0363	7.2	35.7
4,000	0.0460	8.7	46.0
5,000	0.0575	10.7	58.0
6,000	0.0725	13.7	72.7

* The above figures are taken from the paper by Messrs. G. A. Abderegg and B. W. Kendall describing this cable, and presented to the Midwinter Convention of the American Institute of Electrical Engineers, New York, February, 1922.

Three separate cables of the above type were made and laid in contiguity in the Florida Straits in 1921. They were manufactured and laid by the Telegraph Construction and Maintenance Company of London for the American Telephone and Telegraph Company, U.S.A.

(To be continued.)

Reviews of Books, &c.

[***Books noticed in this column will be sent from*** **Electricity** ***Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.***]

The Electrical Engineer's Year Book, 1924. 486 pp., illustrated. (S. Davis and Co. 21s. post free.)—We have great pleasure in again bringing to the notice of our readers this well-known year book and diary, now in the sixteenth year of its publication. The size and scope of the volume are so great that it is impossible to do justice to them in the space here available. Much of the volume is occupied by specially written articles dealing with modern practice in the generation of electricity; the selection and installation of cables, the application of electricity for power, heating and cooking purposes and for lighting; and the installation of telephones and bells. There are also sections on electric vehicles, official rules and regulations, and the all-important problem of trade promotion.

The lists of electricity supply authorities in the U.K., of London streets in which mains are laid, and of central stations, showrooms and contractors' shop windows remain as useful as ever. As for many years past, we shall keep this year book ready for instant reference, and doubtless we shall find it always helpful and reliable. The only suggestion we can offer is that purchasers would find it convenient to have a list of the revised and new sections, so that they could read these carefully and get posted at once with the latest information.

Fowler's Mechanical Engineer's Pocket Book, 1924. 3s. net.

Fowler's Electrical Engineer's Pocket Book, 1924. 3s. net.

Fowler's Mechanic's and Machinist's Pocket Book, 1924. 2s. net.

(Manchester, Scientific Publishing Co.)

These three annuals are now before us, and as they have all held a high record for many years as text-books of direct value to the clientèle for which they have been written, the new editions do not call for much comment. Due care has been taken to make such revisions and corrections as will keep the contents in line with present-day practice, and the only criticism we would make is that in some pages the type shows signs of wear, due doubtless to the constant demands for reprints. Re-setting would be an improvement in several sections, and Mr. Fowler, who is a Whitworth Scholar, holds such a reputation for the care and accuracy of his literary work that we quite expect he will appreciate the need for clear type, particularly for the setting of mathematical formulæ.

Working of Steam Boilers. By E. G. Hiller, M.I.C.E. Sixth edition. (Manchester, National Boiler Insurance Co., Ltd.; London, Rentell. Cardboard 3s. 6d., full cloth 5s.)—Mr. Hiller's book of instructions respecting the working, treatment and attendance of steam boilers has commanded a ready sale for so many years that new editions are bound to follow each other as regularly as clockwork, and the boiler attendants or responsible authorities in charge of steam boilers who have not made themselves acquainted with the contents of this most useful book should certainly do so without delay. The author and the inspectors of the insurance company, of which he is the chief engineer, have had such wide experience in the supervision of boilers of all classes that there is practically no problem in boiler working with which this book does not cope, and it can be recommended without hesitation.

Atoms and Electrons. By J. W. N. Sullivan. (Hodder and Stoughton, Ltd., 2s. 6d. net.)—Of all the books published on atoms and the electron theory this is surely the clearest and the most complete and concise. Mr. Sullivan not only knows his subject, but he leads the reader easily step by step through the intricate theories that go to make the whole structure of the science. The publishers state that the ever-increasing demand for knowledge is one of the happiest characteristics of our time. We entirely agree, more especially if the knowledge is handed out in a manner whereby it may be acquired as easily as reading a novel. It would hardly be possible to obtain a better general view of the subject than by reading Mr. Sullivan's book. The impressions it gives are very varied. The first is the importance of the metric system, the last the obvious accuracy by which a theory may be formulated on the law of probabilities. And in between the idea that the philosopher's stone may even yet come to pass. If you wish for a clear conception of the atomic theory, then buy Mr. Sullivan's book.

Wireless Telephony Explained. By J. Hartley Reynolds and G. L. Morrow. (Cassells, 1s. 6d. net.)—A very interesting and instructive handbook well above even the usual standard of the series of "amateur wireless" handbooks, of which the volume forms part. Essentially a practical work and not full of theory, it takes its reader, step by step, through the principles involved and the apparatus used. The book is amply illustrated, and the diagrams are clear and good. The chapter on aerials and earth is worthy of note, and the aerial diagrams do not show the faults that unfortunately so many authors overlook. Such usual faults are, in fact, pointed out, and readers are shown how to avoid them. Another good point is that the circuit diagrams show by-pass condensers in their correct places and where they are required. This alone is useful, and is omitted in many diagrams found in other works on the subject. A large number of useful diagrams are included both for receiving and transmitting sets, including Armstrong circuits, Flewelling and reflex sets in general. Altogether it is a useful book, and should be purchased by every wireless amateur.

The Electric Supply Share Handbook. By Hubert Blake. Cr. 8vo, cl., 136 pp. (Effingham Wilson, 5s. net.)—This is an interesting book which will appeal to stockbrokers as well as to central station engineers and others who are interested in the shares of those electric light and power companies which are quoted officially on the Stock Exchange. It is clearly printed, and contains a large amount of useful information in regard to share capital, loan capital, powers, operations and results, as well as giving the names of the directors of each undertaking.

Kelly's Directory of the Electrical Industry, Wireless and Allied Trades, 1924. (Kelly's Directories, Ltd., 30s. net.)—In the first edition of the above book, which has just been published, the arrangement follows that of Kelly's well-known Trade Directories, whereby the name and address required can be instantly obtained either according to district or to trade. It also contains two general alphabetical lists, one for London and one for the rest of Great Britain and Ireland. It is divided into seven principal sections:—

1. An alphabetical arrangement of names in the towns and villages under each county, with information as to the populations, sources of electrical supply, market and early closing days.
2. An alphabetical list of public lighting, power and traction undertakings, with particulars of system and voltage and the names of officials.
3. An alphabetical list of London and its suburbs—that is, a list of all persons and firms engaged in or connected with the electrical trades in London and its suburbs.

4. A general classification of trades for London and its suburbs—that is, classified lists of professions and trades connected with the electrical industry in alphabetical order, with the names given alphabetically of those engaged in such professions and trades.

5. An alphabetical list for the rest of the United Kingdom and Ireland.

6. A general classification of trades for the rest of the United Kingdom and Ireland.

7. An extensive list of proprietary articles and trade names, which gives the maker's name and address after the name of each article.

The printing and binding are of the usual Kelly quality, and it is certain to be accorded a hearty welcome throughout the electrical industry.

BRITISH STANDARD MARKING FOR SWITCHBOARD BUS-BARS AND CONNECTIONS (1s. 2d. net post free).—The B.E.S.A. has just issued this publication, No. 158-1924, which contains rules for the colouring and marking of bus-bars and connections, the connection of generators to bus-bars, a description of the points of view of drawings and diagrams (with illustrations), arrangement of bus-bars and connections for three-phase systems, as well as instructions regarding diagrams of switchboard connections. Copies may be obtained from the B.E.S.A. Publications Dept., 28, Victoria St., S.W.1, or from ELECTRICITY office, price 1s. 2d. post free.

"THE ELECTROLUNALYTIC'S ALPHABET."*

"A dreadful inspiration
After too much celebration,
Over long examination,
Which prompted this oration."

BY "R_{T2}."

"A" for the "Amperes," about which we learn.
"B" stands for "Flux," which is made when they turn.
"C" is the "Current" containing the amps.
"D" is the "Dimmer" that douses the lamps.
"E" the "Electrics" they make at the station.
"F" the "Frequency" of each alternation.
"G" is the "Galvo," used by some with reluctance.
"H" is for "Henry," who appears in inductance.
"I" for the "Ions" in science so prevalent.
"J" for old "Joule" and his heating equivalent.
"K" is the "Kathode," a fellow charged negatively.
"L" for "Inductance," which is caused so magnetically.
"M" are the "Manuals" we scan with attention.
"N" is the "Node" that's produced by reflection.
"O" stands for "Ohm," whom we all should praise.
"P" is quite different, but rhymes, as its "Phase."
"Q" is the "Quantity" measured by Coulomb.
"R" the "Resistance" which Ohm made his rule on.
"S" are the "Sparks" that fly when we're careless.
"T" for "Transmission" by cables and wireless.
"U" for the "Underground" trains all electric.
"V" for the "Volt" that gave you that bad kick.
"W," "Watts," they are things very powerful.
"X" is "Unknown," and the answer is doubtful.
"Y" is a letter we haven't much use for.
"Z" for "Impedance," and the end of the uproar.

---

* From the *Faraday House Journal*.

Various Items.

The I.E.E. Dinner.—Members intending to be present at the next annual dinner of the Institution of Electrical Engineers (Thursday, February 21), and who have not yet made application for tickets, are reminded that they should do so as soon as possible.

Finance.—The directors of W. T. Henley's Telegraph Works Co., Ltd., recommend a final dividend on the ordinary shares of 2s. per share, less income tax, making, with the interim dividend of 1s. per share paid on September 1, 1923, 3s. per share for the year.

Obituary.—We regret to record the death, on the 31st ulto., of Mr. F. S. Dennison, of Siemens and English Electric Lamp Co., Ltd., 38/39, Upper Thames Street, E.C.4. He was for some years with the G.E.C., but for over sixteen years has been associated with Messrs. Siemens, and latterly has been one of their chief assistants in the lamp department. He is sadly missed by all his colleagues.

Mexico.—We have received from D. O. T. a report on the economic conditions in Mexico, and we notice on page 16, in regard to the opportunities for British trade, that electrical machinery is required by the various firms and transportation companies, and there is also a demand for small electrical products such as low power dynamos and household equipment. The price of the report is 1s. 1d. post free from H.M. Stationery Office or ELECTRICITY Office.

An Office Novelty.—Readers of this paper who would like to have a really useful and at the same time a novel desk companion, should make a point of writing at once to Mr. J. C. White, of the Electrodome, 49, Bridge Street, Deansgate, Manchester, and asking if he can spare them one of his J.C.W. 1924 souvenirs, in the shape of a combined ash tray and vertical pen rack arranged in a very novel and convenient form, which will appeal to all who are fortunate enough to receive it. It is just the thing for an office desk or table.

Social.—On Friday, the 1st inst., the staff of the Siemens and English Electric Co., Ltd., held another of their happy social evenings in the large but comfortable room at the top of the premises in Upper Thames Street. The whole programme went with a swing from the start to finish, and it is impossible to discriminate in the way of excellence, because the turns were all remarkably amusing and were received with the most cordial applause. We can, however, congratulate Mr. W. W. Wilmot on his skill as stage manager, and Miss Skelton is certainly an able pianist. At the end of the first part of the entertainment refreshments were served in the showroom on the first floor, after which dancing was indulged in on the fourth floor and greatly enjoyed.

Faraday House.—The Faraday House Journal for the Lent term opens with a splendid portrait of the Rt. Hon. Lord Castleton, K.P., C.P., C.M.G., who is the chairman of the governors of the Institution. It also contains various interesting news and articles, as well as particulars of the progress which is being made by the old students in all parts of the globe. A separate slip gives details of the annual examinations for a Faraday scholarship of fifty guineas per annum for three years and a Maxwell scholarship of fifty guineas per annum for two years, which are due to be held at Faraday House on April 8, 9 and 10 next. Further particulars may be obtained on application to the Secretary at 62/70, Southampton Row, London, W.C.1.

Demonstration Visit.—On the 6th inst. the third year mechanical engineering students of the Regent Street Polytechnic School of Engineering visited the demonstration rooms of the Lighting Service Department of the B.T.-H. Co., Ltd., to hear an address and witness industrial and domestic lighting demonstrations. They were accompanied by Major T. Worswick, O.B.E., M.Sc., Director of Education, Mr. A. R. Horn, O.B.E., B.Sc., M.I.Mech.E., Head of the School, and Mr. P. Kemp, M.Sc., M.I.E.E., Head of the Electrical Engineering Dept. The proceedings were conducted by Mr. W. E. Bush, Manager of the Lighting Service Department, who in an address and lecture made comparisons between obsolete lighting systems and what is considered to be ideal lighting for industrial interiors. The evils of glare, the dangers of harsh shadows, and the benefits to be derived from ideal lighting were demonstrated in a convincing manner. Demonstrations of this kind are appreciated by the students of technical schools and colleges, since they can see the application of the technical details of illumination applied in a practical way.

Works Visit.—On Wednesday afternoon, the 27th inst., the students of the Inst. of Civil Engineers will visit the Osram Lamp Works.

Tenders Accepted.—The Admiralty have accepted the tender of the Edison Swan Electric Co., Ltd., for the supply of metal filament traction type lamps.

Obituary.—We regret to announce the death of Mr. W. G. L. Riddle, past-president and honorary life member of the Birmingham and District Electric Club.

Meetings.—At the meeting of the Junior Inst. of Engineers, which is due to be held on Friday, the 29th inst., at 39, Victoria St., at 7.30 p.m., there will be a lecturette, "The Manufacture of the Incandescent Electric Lamps," by W. A. Rhind, M.I.S.I. (member).

Wembley.—The name of the London Electric Firm was accidentally omitted from the first list of exhibitors at the British Empire Exhibition, and they ask us to advise our readers that they have taken a prominent position, where they will show searchlights, lamp-lowering gear, electric heating appliances, and, in fact, all their specialities.

"**The Arc.**"—Issue No. 3 of the bulletin of J. Halden and Co., Ltd., the well-known makers of drawing instruments, is accompanied by a most humorous page of sketches entitled "Keep Smiling," by the well-known artist, Mr. W. Heath Robinson. It is therefore certain of a hearty welcome in every drawing office. The editorial text is also of the usual interesting nature.

Social.—The ladies' night concert of the Electro Harmonic Society, which was held at the Caxton Hall on Friday, the 8th inst., was well attended, and as the programme provided was of real excellence it was much appreciated by all who were present The star of the evening was undoubtedly Mr. Norman Allin, the baritone, whose songs were received with very hearty applause.

The George Montefiore Triennial Award.—We have received a copy of the conditions governing the award of the Montefiore prize, the next competition for which will be held in 1925. The prize will, on this occasion, be 22,500 francs (Belgian), and it will be awarded by an international committee for the best original work submitted in the field of scientific advance or progress in the technical applications of electricity. Full particulars may be obtained from the General Secretary of the Assoc. des Ingenieurs Electriciens de l'Institut Montefiore, Rue St. Cilles, Liege, Belgium.

Plant Wanted.—The Post and Telegraph Dept., Wellington, N.Z., invite tenders for the supply and delivery, at Wellington, of 20 miles of copper wire, 1/20, vulcanised rubber insulated, taped and braided to specification No. 116.——The State Electricity Supply Works at Montevideo invite tenders for the supply and delivery of six generating sets, each supplied complete with accessories and spares and consisting of a Diesel oil engine and a generator directly coupled.——The Victorian Govt. Rys. invite tenders for the supply and delivery of alternating current induction motors, starting apparatus and accessories. Specifications, etc., at the D.O.T. (Room 52), 35, Old Queen Street, S.W.1.

Telephony.—A new series of books on the "Principles and Practice of Telephony" is announced by the McGraw Hill Publishing Co., Ltd., and full particulars appear in the advertisement pages of the current issue. The author is Mr. Jay G. Mitchell, the well-known telephone engineer, and the publishers are offering the set of five volumes on special easy payment terms, which should appeal to the very large number of readers of this paper who are associated with the telephone industry in this country. We hope, therefore, that they will follow up the advertisement referred to.

Public Lighting.—The first conference of the new Institution of Public Lighting Engineers and Superintendents is to be held on Friday, 15th inst., at 2 p.m., in the Holborn Borough Council Offices, 157, High Holborn, opposite the British Museum Station of the Central London Railway, and a small exhibition of some of the most modern street lighting appliances will be held in connection therewith. The first president, Mr S. B. Langlands, the Public Lighting Superintendent of the City of Glasgow, who will preside at the conference, will deliver his presidential address, and a short paper on Street Lighting will afterwards be submitted by Capt. W. J. Liberty, Public Lighting Superintendent of the City of London, in connection with which there will be a demonstration of the centrally suspended high-power electric and gas lamps in the City, and an inspection of the public lighting of the Metropolis.

NATIONAL INCREASE OF WAGES.

In accordance with the agreed recommendation of the National Conference of the National Federated Electrical Association and Electrical Trades Union at Manchester, on February 7, all rates of all grades will be increased by reverting to the reduction of 27 per cent. on the April, 1921, rates, to come into effect on the first pay day following Sunday, March 2, 1924, for the period covered by that pay day.

The revised rates under the National Wages Agreement for electrical contracting industry, payable on the day following March 2, 1924, will be as under:—

Grade A	1s. 10d.
(This rate includes a travelling allowance, no further allowances to be paid except as provided by Rule 9 of the London Rules dated February, 1920.)	
Grade B	1s. 7¾d.
Grade C	1s. 6¼d.
Grade D	1s. 4¾d.

The above rates will come into effect on the pay day following March 2, 1924, for the period covered by that pay day, and will remain current up to and including December 31, 1924.

Trade Notes.

Messrs. Money, Hicks and Mills, Ltd., 297, Haydons Road, S.W.19, have issued a price list of engraved ivorex and ebonex wireless scales, terminal labels, etc., which will interest all manufacturers of wireless apparatus, and they will be pleased to send it to any trade reader on application.

We have received from the **Marconi Co.** a copy of their pamphlet No. 225, which deals with the company's Infantry and Observation Post set, type "Y.P. 1." In common with other pamphlets issued by them, the subject is introduced by general notes, which clearly explain the scope and function of the apparatus. The sets described are specially built to maintain uninterrupted communication between observation posts and their respective gun positions, a matter of vital importance in every campaign, and the lack of suitable apparatus of this kind in the early stages of the European war was undoubtedly the cause of the heavy casualties in the ranks of Artillery brigades. While Wireless Telegraphy or Telephony is the ideal means of communication for this purpose, there are certain technical difficulties which have had to be solved, the greatest being that of the high selectivity required in reception to enable a large number of sets to work simultaneously in close proximity to each other on a limited front. The company's experience of Duplex telephone working has been of considerable service in enabling them to design the Y.P. 1 sets, which are specially selective for the purpose outlined. The result is apparatus extremely light, and portable. The pamphlet gives very interesting details concerning the methods adopted, the wavelengths found suitable, and the types of aerial, and very clear illustrations are shown of the apparatus, its components, and design. A special point of interest is that Telegraphy is carried out by buzzer modulation of the carrier wave, special buzzers having a variable note of almost perfect constancy being provided for the purpose, and further, the statement that as many as sixteen stations may easily be worked simultaneously within an area of three square miles, without mutual interference, is a testimony to the efficiency of the apparatus.

ARMATURE REPAIRS
MARRYAT & PLACE.
28, HATTON GARDEN,
LONDON, E.C.1.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

FEBRUARY 22, 1924.

CONTENTS. PAGE

Loud-Speakers 93
Armature and Coil Winding from a Conversion Point of View 94
Electrification of the French Midi Railway 95
Current Topics 99
Problems in Telephony, Solved and Unsolved 101
Questions and Answers by Practical Men 102
" Storage Battery Troubles " 104
Reviews of Books 104
The N.A.S.E. Dinner 105
Various Items 105
Trade Notes 106

LOUD-SPEAKERS.*

BY A. NYMAN, RADIO ENGINEER, WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., U.S.A.

The loud-speaker is really the voice of the radio, converting the radio set into a musical instrument. Like any voice, it may be good or bad, and therefore a careful selection of the loud-speaker should be made with regard to its quality, volume and purpose, in order to be sure that the sound it gives will correspond to the sound sent out from the radio station.

It is a well-known fact that any sound can be regarded as vibration in air. Such sounds are vibrations at a definite rate, or pitch; others are vibrations at an irregular rate of rising or falling magnitude. You can distinguish between a pure sound of a definite and continuous pitch, such as the sound of an organ-pipe or a flute; a complicated sound, which may consist of a blending of a number of pitches, as the voice of a person; or an abrupt sound, like the sound of a piano. It is evident that a complicated or an abrupt sound is much more difficult to reproduce than a pure sound.

The loud-speaker, which is to reproduce all the musical instruments, and also all the voices that may be transmitted over the radio, must contain the qualities of all the different voices and instruments to be able to reproduce all sounds without any of its own characteristics. So far no loud-speaker has fully achieved this perfection. Any instrument possessing a horn, a diaphragm or a reed will have its own characteristic sounds, which may be suppressed to a certain extent, but not entirely eliminated. It remains with the listener to decide which loud-speaker is most capable of reproducing the largest number of instruments and voices with the greatest fidelity.

Almost all loud-speakers will reproduce a pure note with a fair degree of accuracy. If a pure note gives a rattling or scratching sound, it is certain that the loud-speaker cannot reproduce a complicated sound; but, on the other hand, the fact that a pure note comes through clearly does not necessarily mean that a complicated sound will be faithfully copied. The same loud-speaker may reproduce a low-pitched note much weaker than a high-pitched note. A complicated sound, which contains both these pitches, will appear distorted because its low-pitched component will be weak compared to its high-pitched component.

This shows two qualifications necessary in a good loud-speaker. The first is clearness of pure sound at different pitches; the second is equal loudness of sound at different pitches. But even these qualities are not sufficient to reproduce all complicated sounds correctly. A third necessary qualification is that in a complicated sound the individual pitches should get through in the same proportion that they have in the original sound. A fourth qualification is that the natural sound of the loud-speaker should be eliminated as much as possible. The natural sound of the loud-speaker is dependent on the horn more than anything else. The longer horn gives the effect of a lower and a more pleasing pitch. By a suitable design this effect can be reduced to its correct proportion.

A person desiring to choose a loud-speaker with the best qualities possible should make the following tests :—

First: Listen for a pure sound, such as that from an organ or a flute, or from a clear voice singing a sustained note; or, if such tones are not available, the usual kind of "howl" on the radio set may be used. If you run this howl through the full range, you can tell fairly well if any particular pitches come through unusually loud, or if other pitches are somewhat weak. If the loud-speaker gives all pitches without a rattle, and a fairly even volume, you may expect this loud-speaker to give a rather good reproduction of all kinds of music. If one or two notes are particularly prominent, you will find that in reproducing music these notes will always ring too loud, and if the voice happens to strike these notes they will distort the quality of the voice. However, if one or two notes are missing, the quality is not impaired to any great extent. It is only when a range of notes is missing (for instance, all the low notes or all the high notes) that the quality of both music and speech will be impaired considerably.

This test by means of the "howl" of the set will, as a rule, show you better than any particular selection of music or voice whether a loud-speaker can reproduce all kinds of music and voice satisfactorily.

The second test is made with piano notes. The piano gives a very abrupt sound, generally consisting of a blending of several pitches, which are known in music as the fundamental and its overtones. In order to reproduce this sound correctly, the loud-speaker must have superior qualities. Sometimes the low notes on the piano seem to come through very clearly, but, somehow, a musician would not think that the piano is reproducing correctly. He would speak of it as sounding "tinny." This would give a fair indication that these low notes miss their fundamentals and only reproduce their overtones, or high pitches.

A third test, and probably the most important, is the test of the voice. The voice, particularly the speaking voice, is an extremely complicated sound. It consists, generally, of a blending of a number of pitches. Sometimes as many as twenty or thirty pitches are necessary to produce the quality and the inflection of the voice.

---

* *Telegraph and Telephone Age*, N.Y.

An increase or decrease in any one of these pitches will change the quality or inflection. Personal judgment is, of course, the only way to determine the quality of the loud-speaker. If you hear a person, whose voice you know, talking by radio, you can judge the quality of the loud-speaker by the naturalness of the voice, particularly by its inflections. The pitch of your friend's voice may appear lowered or raised a certain amount, due to characteristics of the horn, but that would not necessarily impair the quality. If you do not know the person talking, the best test you can make is to get far away from the loud-speaker and try to understand what is being said. With a good loud-speaker it is possible to go to a different part of the house, shut the door, and yet understand clearly.

In addition to clearness, another quality of speech should be considered also. A loud-speaker may give very clear speech, but with an accent on some particular sound, as the "ah" sound. Although this does not necessarily make the loud-speaker undesirable, yet the effect of this accent during a long talk will probably be annoying and cause some of the listeners to beg to have it shut off.

In testing the loud-speaker, and also in using it, it is essential that the radio station, the radio set, and the amplifier with which it is used all give good quality. A poor amplifier, or a radio set improperly adjusted, will make the best loud-speaker sound like the worst. It is sometimes difficult to get a distant station on the loud speaker to sound clear. The usual effect is to accentuate the low notes and suppress the high ones. All voices are pitched low, and the music seems to consist of the booming of drums and the low notes of the piano or orchestra. This effect is due to the closeness of adjustment of the set, and can be corrected only by the use of a more powerful set which does not require such close adjustment.

In conclusion, let us consider the place where the loud-speaker is to be used. In an ordinary living room of a small house, it is not necessary to have a loud-speaker that gives a large volume of sound. Quality is far more important, and a weak loud-speaker with a good quality will be found far superior and more pleasing. A loud-speaker capable of an enormous volume has its uses for outdoor demonstrations, dance halls, or auditoriums. A house with large rooms, where the loud-speaker may be used for dancing, requires a fairly large volume from the loud-speaker. As a rule, dance music must be made louder that speech or music of purely artistic value.

The **D.P. Battery Co., Ltd.**, of Bakewell, Derbyshire., are issuing a useful blotter with a charming illustration in colour showing the Holme Bridge and Ford at Bakewell.

Leaflet B.C. 3208, which has just been issued by the **G.E.C.**, describes and illustrates a 5-valve Gecophone cabinet receiving set which has recently been put on the market by the company. It contains one stage of high-frequency amplification, a detector valve and three stages of low-frequency amplification, and is an ideal instrument for use in conjunction with the loud-speaker. The wave length of the set covers all B.B.C. stations in this country, and extra coils can be obtained to cover Continental broadcasting if desired. Trade dealers can obtain copies of the leaflet from Magnet House, Kingsway, or from any of the company's provincial branches.

ARMATURE AND COIL WINDING FROM A CONVERSION POINT OF VIEW.

By C. Sylvester, A.M.I.E.E., A.M.I.Mech.E.*

(Continued from page 49.)

It is often necessary to rewind motors for various voltages, especially on site where conversions from one voltage to another are being carried out. From what has already been written it will be seen that any decrease of voltage across the terminals of a circuit will result in a decreased quantity of current through that circuit, with a consequent decrease in the resultant lines of force through the magnetic circuit. This means that when it is desired to operate a motor upon various voltages certain conversions have to be carried out, that is, if the motor is to develop the same power. Let us discuss the circuits through a motor and see how a varying voltage will affect the factors concerned.

Fig. 6 illustrates the circuits through a compound motor, *SH* being the shunt winding, consisting of four coils in series, *A* is the armature and *SE* is the series field. We will assume that the resistance of the shunt field is 100 ohms and that the voltage is 400 volts.

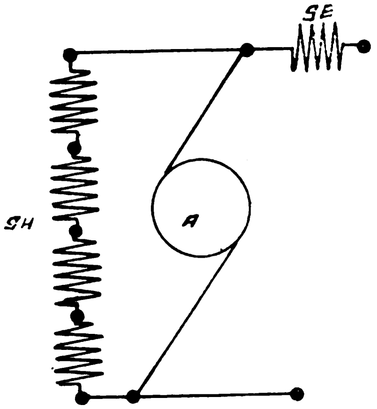


FIG. 6.

Now since $C = \frac{E}{R}$ it will be seen that the current through this winding will be approximately 4 amperes, that is, ignoring the slight drop of voltage which will occur in the series coil, and which must, strictly speaking, be deducted from the supply voltage. This drop, however, need not be considered, since it will not affect our calculations to any great extent. The shunt coils, being divided into four distinct coils, will have a drop of 100 volts across each coil.

Now it is well known that the magnetisation curve of a motor or generator is not a straight line by any means. If, therefore, assuming the iron to be well saturated, it will be seen that an increase of voltage, although it will produce a resultant increased current, will not to any great extent increase the flux density in the magnetic circuit. On the other hand, a decreased voltage and, consequently, a decreased current, will considerably weaken the flux in the magnetic circuit.

---

* "Armature Winding," by Mr. C. Sylvester, is a clearly written practical work for the armature winder. It may be had for 8s., post free, from ELECTRICITY Office.

Let us assume that we desire to use the 400-volt motor on a voltage of 200 volts. If the machine is to develop the same horse-power there are factors which have to be considered, since half the voltage means half the field strength and half the pressure across the armature winding. We will also assume that the armature is wave wound.

Considering the shunt field first, it is clear that if the iron is to remain at the same point of saturation, the current through the shunt coils must remain the same, since the number of turns on the shunt field coils is constant, that is, if we do not wish to rewind the coils. The latter is an expensive and undersirable arrangement and should be avoided if possible. If the coils are to be rewound, then if 4 amperes is to traverse the shunt-field circuit, its resistance must be reduced to 50 ohms and the number of turns must remain the same as before. This can be accomplished by rewinding the coils to the same number of turns with wire of twice the cross sectional area as used before. This method is wasteful, since the only object of the increased copper is to decrease the resistance of the circuit.

A much better method is illustrated in Fig. 7, which shows the shunt-field system with two coils connected in series and, with the other two similarly connected, placed across the 200-volt supply. From this it will be seen that we have now two circuits, each having a resistance of 50 ohms across the supply of 200 volts. This allows 4 amperes to pass through each circuit, with the result that the field strength is the same on the new voltage as before.

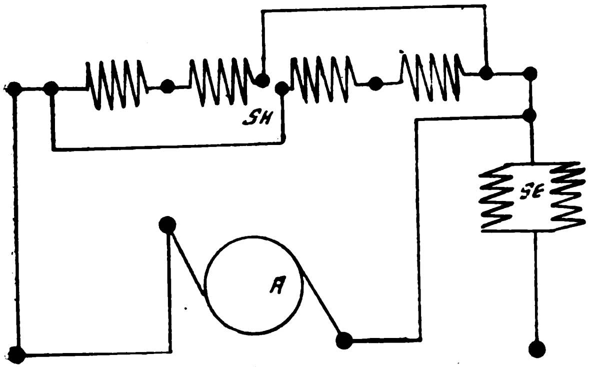


FIG. 7.

We will now consider the series field. Since the motor has to develop the same horse-power on 200 volts as it did on 400 volts, it follows that now the voltage is halved the current input will be doubled. This means that the amount of current through the series field will be doubled, since this winding is in series with the armature.

If we adopt the same method as we did with the shunt winding, that is, parallel it so that half the armafure current flows through it as shown in Fig. 7, then we can use this winding to supply the same number of ampere turns as before without having to rewind it.

We will now consider the armature winding.

(*To be continued.*)

Reduced prices for mercurials are announced by **May and Baker, Ltd.**, manufacturing chemists, of Battersea, S.W.11, in a circular dated February 4. These reduced prices will perhaps be of interest to various readers who are associated with the manufacturing industries.

ELECTRIFICATION OF THE FRENCH MIDI RAILWAY.*

By A. BACHELLERY, Ingénieur-en-Chef, Chemins de Fer du Midi, France.

(*Continued from page 82.*)

Passenger trains are lighted and heated by current obtained from the engine through special couplers. The lighting current at 120 volts is taken from the machine's auxiliary group.

Heating is provided by 1,500-volt current from the line. This current is sent into radiators placed under the seats in the car compartments and protected by steel tubes and perforated steel plates. The heating couplers between the cars are so designed as to prevent dangerous arcing while uncoupling. To secure this, an auxiliary wire fed with low-tension current runs throughout the whole length of the train. Its couplers are mechanically interlocked with the heating couplers, so that the latter cannot be uncoupled unless the former have been previously uncoupled, which automatically results in the opening of the main switch controlling the heating circuit on the locomotive.

A series of 90 of these machines is under construction, 13 of which are already running.

The freight locomotive is to haul trains up to 1,800 tons on the level. On mountain lines, this same engine can haul a 185-ton train on a 4 per cent. grade. A helping engine at the rear will be normally used on these lines.

Another type of machine is a motor-car for suburban and branch-line services. It is carried on two 4-wheel bogies of the swinging bolster type. Each of the four axles is driven by a series nose-suspended geared motor. These motors are wound for 750 volts and connected two in series. They are self-cooling. The continuous rating of each is 125 h.p., and the one-hour rating 175 h.p. The maximum speed is 50 miles an hour.

Each axle has only one gear, similar in construction to those on the locomotives. The tractive effort is transmitted from the truck frame to the swinging bolster through articulated drawbars instead of the ordinary friction plates, which wear out quickly and impair the bolster's lateral displacement. The motor control is the same as on the locomotives. Air and hand-brakes and electric rheostatic braking are provided.

The car is entirely of steel. It includes a third-class compartment with central aisle and reversible seats, a luggage compartment and two drivers' platforms. The total weight of the vehicle is about 52 tons and the number of seats is 48, besides which 32 standing passengers can be accommodated.

Those three types of machines are sufficient to haul any kind of train, either on mountain or level lines, up to 50 miles per hour; but for higher speeds a special type of express locomotive had to be designed.

This problem is still under consideration in many countries, and could scarcely be said to have found an entirely satisfactory solution up to now.

The trouble, which is more of a mechanical than of an electrical character, consists mainly in the transmission between motor and driving axle. In the case of an express locomotive, the ordinary gear transmission requires a high peripheral speed for the pinions, at which their lubrication becomes very difficult. This difficulty disappears in the gearless type of locomotive where the motor armature is fixed directly on the driving axle; but then the unsprung load increases to such a point as to tell severely on the track. To lighten this, the motors are often set in the cab and connected to the axles by means of driving rods. But this construction generally results at high speed in abnormal vibrations of the machine and in stresses leading to breakage of rods, cranks and even of the engine frame.

---

* Paper read before the I.E.E. on November 22, 1923

In order to avoid these various difficulties, the Midi Company has kept, for its high-speed locomotive, to the geared type, but with entirely suspended motors and quill drive. The particular feature is the use of a conical gear which allows smaller pinions and a lower peripheral speed and, moreover, is easier to lubricate than a straight gear.

Two locomotives previously built for use with single-phase traction was transformed according to this programme by the Société des Constructions Electriques de France. The general disposition of these machines is 4—6—4, that is, three driving axles independent of each other, and a four-wheel bogie at each end.

The driving wheels are 69 inches in diameter. The adhesive weight is 54 tons, and the total weight 102 tons. The bogies are elastically centred and are practically identical with steam-engine bogies.

The equipment of each driving axle is composed of a pair of vertical motors placed inside the cab and fixed to the main frame. The two pinions drive a double-cone gear-wheel fixed on the middle of the quill, and this in turn acts on the driving wheels through an elastic transmission

The motor shafts are suspended on ball bearings at their upper extremity. At the lower end, the whole gear is immersed in oil. A pump raises the oil to a tank at the top of each motor, whence it flows down through ducts bored in the motor shaft.

The six motors are wound for 500 volts and are connected three in series. They are four-pole motors (two active and two consequent poles) with commutating poles. The one-hour rating of each is 375 h.p., that is, 2,250 h.p. for the whole machine. These motors, of very peculiar construction, have been designed and built at Liège, in the works of the Société des Constructions Electriques de Belgique, another firm associated with the Constructions Electriques de France.

The motor control is of the same type as in the former machines, and the maximum speed is 75 miles per hour. No electric braking has been provided for these machines, which are only for level lines. They are fitted with the Westinghouse automatic and straight air brakes.

The current-collecting apparatus consists of three pantagraphs similar to those previously described, each of which can collect, without sparking, 800 amperes at the maximum speed.

The machine has been tested up to a speed of 78 miles per hour, keeping perfectly steady on the track, without any nosing. This will perhaps be a surprise to those who believe that a locomotive with a symmetrical wheel-base cannot run smoothly at very high speeds. It may be of interest, therefore, to look into the matter more closely and to ascertain the origin of this somewhat legendary belief.

The above expressed opinion was made by the Pennsylvania Railway officials, as the conclusion of tests carried out in 1907. These tests included the following machines :—

(1) Several steam locomotives, either American or Atlantic type.
(2) An electric locomotive with two driving axles rigidly connected to the frame and a four-wheel leading truck (a disposition quite similar to that of an American type steam locomotive).
(3) Several electric locomotives with two four-wheel trucks.

In fact, the symmetrical engines were limited to this last type, which behaved fairly badly at express speeds Whilst, however, this inferiority was too hastily attributed to symmetrical construction, its real cause, to my mind, was quite different : first, the lack of a rigid wheel-base, owing to which a two-truck machine has a tendency to sway at high speeds; second, the rigid fixing of the pivots on the truck frames through which the side blows are transmitted from the track directly to the main frame; third, a centre of gravity decidedly lower than that of the steam engines.

The verdict thus delivered against symmetrical engines cannot, therefore, be considered to be final. Several engines—either electric or steam—which show perfectly symmetrical wheel arrangments, and ride nevertheless without difficulty at a fairly good speed, have before now brought it under suspicion; and the author will venture to say that the Midi Company's express locomotive has given it the final blow.

It will be noticed that this machine has been so designed as to avoid precisely the three defects which have just been pointed out. It has a rigid wheel-base 13 ft. long, which keeps it steady on the track. The trucks are elastically centred through side springs; and, owing to the raised motors, which are set inside the cab, the height of the centre of gravity is similar to that on a steam engine.

This type has been adopted for a series of express machines to be built for level lines; but a new and more powerful machine of similar construction, with four driving axles and a normal rating of 3,200 h.p., is already under consideration. It will pull on a level a 600-ton train at 60 miles an hour, or a 380-ton train at 70 miles.

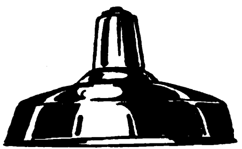
(To be continued.)

Finance.—The report of the Yorkshire Electric Power Co. for the year 1923 shows a very satisfactory state of progress, and the directors recommend a dividend at the rate of 8 per cent. per annum on the ordinary shares, placing £25,000 to the reserve fund and carrying forward over £34,000.

Edinburgh and Lothians Electricity District.—The Electricity Commissioners intend to hold a local inquiry in the City Chambers, Edinburgh, on Monday, March 10, at 10.30 a.m., with reference to this scheme. Copies of the scheme may be obtained, on application, from the Secretary, Electricity Commission, Gwydyr House, Whitehall, London, S.W.1.

Tunbridge Wells.—At the Ideal Home Exhibition held last week at the Pump Room and Sussex Assembly Room excellent displays of electrical appliances for home and business were on view, particularly labour-savers for the home. Demonstrations of electric cookery were also given continuously throughout the period of the Exhibition, and on Wednesday two lectures, illustrated with lantern slides, and dealing with "Electricity—the Home Labour Saver" and "Electricity in the Home," were delivered by Mr. Victor W. Dale, of the British Electrical Development Association.

Don't worry! THERE IS A BENJAMIN REFLECTOR for EVERY CLASS of LIGHTING INSTALLATION.



Advert. of the Benjamin Electric Ltd., Brantwood Works, Tariff Road, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and Abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Tuesday morning, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription : 13s. a year, 6s. 6d. half year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

Those Accumulators.

I am indebted to an esteemed correspondent for some eulogistic remarks on my general condemnation of the small portable storage battery as used for broadcast reception. Although intimately associated with storage battery manufacture, and therefore competent to pass judgment on me had I transgressed, this gentleman is good enough to endorse all I stated in my notes, and adds that his firm receive numerous letters from users of batteries seeking advice in regard to the care and handling of accumulators. Recognising the urgent need for educating storage battery users up to a proper recognition of the attention due to these accessories, and without which they will not give good service, this progressive concern makes a point of issuing a handy little illustrated brochure with each of the batteries sent out by it, and dealing with charging and maintenance hints.

A copy is before me as I write, and, curiously enough, the remarks on mixing acid to produce an electrolyte of the correct specific gravity include a term which I feel sure will be unfamiliar to ninety-nine out of every hundred wireless amateurs, although doubtless in common use by battery manufacturers. The statement is made that all acid used for storage batteries must be prepared from pure sulphuric acid (Sp. Gr. 1840 or "C.O.V.") and distilled water. The expression—C.O.V.—caught me unawares, and although after a little reflection I was able to interpret the meaning of the mystic symbols, it struck me it would be quite a fair test of the intelligibility of the advice given to ask one or two disinterested people who might reasonably be expected to know. I accordingly put the question to a battery traveller, two electrical engineers of considerable experience, and a retail chemist. The first three confessed ignorance, whilst the chemist suggested it was an "electrical" term, and not allied to the chemistry of sulphuric acid.

The real explanation is, of course, "Commercial Oil of Vitriol," the title by which sulphuric acid is known in the industry devoted to its manufacture and distribution. I quote this experience at some length, as indicating how necessary it is for manufacturers of electrical or other technical apparatus, for use by the general public, to be as explicit as possible in any literature intended for circulation among lay users of their products. With this minor criticism, for which I feel sure my correspondent will pardon me, I take the opportunity of congratulating him upon his firm's enterprise in teaching users of their batteries how to obtain the best results from what I have previously described as a laboratory article

Cheap Electricity v. Dividends.

There is a Press campaign in progress at the present time aimed at securing lower rates for electrical energy, more particularly in the areas of Greater London, where it would appear excessive charges per unit are the general rule. In the circumstances it affords interesting food for reflection to glance at a table of recent dividends paid by leading Metropolitan Electricity Supply companies, which, at all events, serve to indicate whether or no the business of generating and distributing electrical energy is a profitable one. Taking the records for 1922 and 1923, as published by the leading financial journal, I note that dividends paid by ten of the leading London companies range from a minimum of 6 per cent. to a maximum of 17 per cent., the average dividend being 11.75 per cent., which I think everyone will agree is an ample return on the capital invested.

Whilst it is quite in order for those companies who have been able to do so to pay dividends of 12, 14, 15, and even 17 per cent., this high ratio of profit on the enterprise of electricity supply is not in the best interests of the industry. It is obvious that if the application of electricity to domestic requirements is to make any headway in Greater London it can only do so on the basis of the cheap unit, and so long as the cheap unit is sacrificed to inflated dividends to shareholders, electrical development must stand still or even slip back to the extent of those consumers who cannot afford to go on paying the high rates now prevailing. In view of the vital importance of the cheap unit to the community, I incline to the opinion that the business of electricity generation and distribution should either be in the hands of a public body or municipality, or alternatively that the dividends paid by any company supplied should be limited to a maximum which will ensure the maintenance of reasonable rates to the consumer.

As exemplifying the urgent need for some such stimulus to be applied to the greater encouragement of electricity consumption in this country, some statistics quoted by Mr. S. L. Pearce, Chief Engineer and Manager of the Manchester Corporation Electricity Department, in a recent lecture to the Junior Institute of Engineers, are of immediate interest. Comparing the extent to which electric power has been developed in various countries, Mr. Pearce stated that the number of units of electricity consumed per head of the population in Switzerland is 700; Canada, 612; Norway, 493; the United States, 472; Sweden, 364; France, 147; and the United Kingdom only 139, or the lowest of any country. Manchester's total is 235, as compared with Chicago's 700, showing that even this electrically progressive city has still a long way to go before it can rival the industrial centres of the United States.

Making due allowance for the greater development of electrical power in those countries which are rich in natural water power as a prime mover, the development, electrically, of Great Britain is still admittedly very backward, and likely to remain so as long as the rates charged for electrical energy remain at their present high average figure. As an example, I was shown the quarterly account of an electricity consumer in a certain northern city the other day. He occupies quite a small house, and in addition to lights, uses one electric radiator very occasionally. His bill for electricity consumed was over £9. The bill for gas for the corresponding quarter also shown me by a neighbouring householder was 14s. 5d., representing just about the equivalent in lighting and heating. With such anomalies existing at present how can we expect the electrical industry to progress?

Those Breakdowns.

That occasional failures of electricity supply are directly associated with changing traffic conditions in our busy city streets was recently exemplified in Deansgate, Manchester, where a four-seater motor-car got out of control and wrecked a switch-pillar, thereby extinguishing the electric arc-lamps from Exchange Station to Bridge Street. As a result of the collision with the pillar, live cables were scattered across the pavement, and for a brief period constituted a danger to pedestrians, but the automatic blowing of fuses quickly isolated the section. The moral to be drawn from this and other similar experiences involving damage to switch-pillars and other surface structures housing electrical cables and associated gear, is that the practice of locating them in busy thoroughfares must be considered obsolescent, having regard to their liability to injury and the consequent interruption to an important service following on any minor street mishap. Junction boxes and the like are obviously more immune from accidental damage below the pavement level than above it.

The A.E.U.

Every month I study, with keen interest, the membership figures of the great Amalgamated Engineering Union, because I am most anxious to see an end to the steady fall in membership. An increase, even if only a modest one, will be a fairly sound indication that the bad times in the engineering industry have at length turned, and that a more prosperous period is coming along. As it is, the February report shows a decrease of over 3,000 in the number of unemployed members, and that is most certainly a move in the right direction, for which we must be sincerely thankful. Taking it all round, the old A.S.E. and the present A.E.U. represent the finest body of skilled and trained artisans of any country in the world, and, what is more, it has been controlled mainly by men of sound common-sense, who at heart have no real sympathy with the feather-brained but loud-spoken street-corner Socialist and demagogue. And there lies the root of the trouble. The real clever workman sticks to his work and says little, while the gasbags go to the branch meetings and talk and raise trouble generally.

More often than not the gasbag is an inefficient worker, who does not apply his brains to the job in hand, with the result that mentally he is less fatigued than the steady skilled craftsman, who has done his utmost to turn out a good job and is therefore genuinely tired after his day's work. To him a quiet evening at home is far more restful than a visit to the branch office to listen to the woes of men who are in many cases work-shy, but full of jaw about the wicked boss, quite forgetting, or wilfully overlooking, the fact that in very many cases the boss is a man from their own stock who has worked his way up in the industry by sheer grit and perseverance, accompanied by the thrift which has ultimately enabled him to use his savings in order to start a small workshop of his own and thus be independent. The bulk of the great engineering works in Great Britain have been built up by such men, and all credit is due to their thrift and enterprise. That is why more self-sacrifice is wanted from the thoughtful men who are now working in the trade. The British public asks them to remember that their sobering influence at the council table and branch meetings may be of material benefit to the industry, and thereby to the country at large.

Which brings me to yet another very heavy handicap from which engineers of all branches are now suffering, and that is the high price of technical books, which are such an essential to all who wish to advance in our great profession. For that they can thank their co-unionists in the printing and block-making trades. Their wages are at figures which make skilled engineers green with envy, and the result is that *technical* book prices are out of all proportion to the engineer's income, with the natural result that he is not so well able to gain the additional knowledge which will help him to earn more money. I am not saying that the compositor or zincographer is not a highly skilled craftsman, but I do say that here in London, or in England generally, he does not have to produce work in competition with the rest of the world. His output, as based on the daily and weekly newspaper reading public, is mainly consumed in this country, and he has not yet met with competition from abroad, although I have just recently seen the imprint "Printed in Saxony" on a technical book, which was excellently produced in English, and more will be sent abroad to Germany and Holland as time goes on.

But the engineer has to build machinery for export to all parts of the world, and as such he is in competition with other great manufacturing nations; and, if the orders are to be obtained at all, the prices quoted must be such as to meet the prices quoted by our competitors. Either that or go without the orders and starve. We must export in order to pay for the food we buy, and that is the reason why wages in the engineering trade have suffered so severely, with the collateral result that the men have not the cash to pay the high prices caused by unions which do not, *at present*, have to face such competition, and, in plain words, are acting as a direct clog on the brain-power of the British working engineer, many of whom are their own kith and kin.

Jubilee Congratulations.

I feel certain that all who are in any way associated with the electrical industry in this country and in the British colonies will join with me in congratulating Mr. H. Alabaster, the chairman of my esteemed contemporary, the *Electrical Review*, on the very happy function at which he was the honoured guest on Friday last, the 15th inst. It was a dinner at the Manchester Hotel, Aldersgate Street, and Mr. E. S. Middleton, the secretary of the company, was in the chair, with Mr. Alabaster on his right, and the enthusiasm with which Mr. Bridge's speech proposing Mr. Alabaster's health was received by all present showed the esteem and affection in which he is held by them. It is something to celebrate one's jubilee as the controlling hand of one of the leading technical papers in the world, and it is therefore possible to appreciate the depth of Mr. Alabaster's feelings when he responded to those who had joined to do him honour. There are probably many people in our industry who have felt the lash of a critical article in the *Review*, but none can say that the power wielded by the journal has ever been abused, and even those who have felt the sting of that lash have, I expect, been well acquainted with the sterling integrity and warm kind-heartedness of the man who was behind it all throughout the half-century. Therefore, I join with the staff of my contemporary in hoping that he and Mrs. Alabaster may yet be spared for many years of quiet retirement, while the engraved silver salver and silver cigar box, presented on the occasion, will always be reminders of the affectionate esteem and regard which has been gained in the course of a lifetime of hard work. Good luck to them both.

ELEKTRON.

PROBLEMS IN TELEPHONY, SOLVED AND UNSOLVED.[*]

By PROFESSOR J. A. FLEMING, M.A., D.Sc., F.R.S.

(*Continued from page* 89.)

We may then say that the problem of loading a deep-sea cable has been fairly well solved, and although we cannot nearly approach to the Heaviside condition for distortionless transmission, viz., $LS = CR$, where L = inductance, S = conductance, C = capacity and R = resistance per naut, we can make a very useful approximation to it. Thus in the case of the Key West-Havana cable we have the following actual measured values of the above quantities at 1,000 p.p.s. :—

$$L = 4.35 \times 10^{-3}\ \text{H} \qquad S = 12.8 \times 10^{-6}\ \text{mho}$$

$$C = 0.315 \times 10^{-6}\ \text{F} \text{ and, } R = 3.32 \text{ ohms}$$

Now $LS = 55.7 \times 10^{-9}$ and $CR = 1.04 \times 10^{-6}$, hence the inductance would have to be increased nearly 20-fold to about 80 mH per naut to fulfil the Heaviside condition for distortionless transmission. Nevertheless we can say that, starting with Heaviside's original suggestion, the successive improvements in loading due to Pupin and Krarup, as put into practice and improved by the careful research of great technical organisations and by the public or Governmental telephone services, have resulted in an extension of the practical telephonic ranges up to, say, 2,000 or perhaps 3,000 miles by aerial lines, 500 miles on underground and 200 miles on submarine cables by suitable loading, as compared with about one-half or one-third of the above distances for unloaded lines of the same type and size.

VII.—THE PROBLEM OF THE TELEPHONE REPEATER.

(14) An additional great extension of the practical telephonic range beyond that due to loading the line has been secured by the invention of the simple yet highly effective thermionic telephone repeater. The invention of a satisfactory telephone relay or repeater has occupied the attention of inventors from the earliest days of telephony, and abilities of the highest order have been brought to bear upon it.

A large number of relays or repeaters have been devised which depend upon microphonic contacts or electromagnetic actions, such as those of H. E. Shreve, S. G. Brown, M. I. Pupin, G. A. Campbell, J. Lyons, and countless others. It is unnecessary to enter into descriptions of these types of repeaters, because the subsequent invention and development of the more perfect thermionic repeater has for many reasons placed them in a secondary position. The evolution of the thermionic repeater started with the invention by me in 1904 of the oscillation valve or thermionic rectifier for high-frequency currents, consisting of a carbon-filament incandescent lamp having a metal cylinder surrounding the filament carried on a leading-in wire sealed through the bulb. The vacuum was specified to be, and made to be, as high as possible.[*] When the filament is incandescent the space between it and the cylinder has a unilateral conductivity, and an electron current flows from the filament to the plate under an external impressed E.M.F., provided the filament is made the negative electrode and the cylinder the anode. I gave in the original Royal Society[†] paper describing this rectifier a diagram of curves which showed the manner in which the current flowing from the filament to the cylinder, now called the *plate current* or *thermionic current*, varied with the potential difference of the filament and cylinder, now called the *plate voltage*. This appliance was used by me as a rectifier for the high-frequency currents employed in wireless telegraphy. I always contemplated and explained its operation as due to the emission of electrons from the incandescent filament, and in my specification insisted on the importance of a very high vacuum to avoid secondary ionisation. As far as means allowed, I endeavoured to produce what is now called a *hard* valve. Some of the early samples were exhausted by the beautiful method invented by Sir James Dewar, depending on the absorptive power of charcoal when cooled in liquid air, for gases. In 1907, Leede Forest, who had been following my work very closely, but employing in a glass bulb a relatively low vacuum, as is shown by his reference to it in his specifications as a "gaseous medium," introduced a zigzag of wire between the filament and the anode plate, which gave the first suggestion for the control of the electron current by electrostatic action. When this suggestion was followed out by introducing into my hard rectifying valve a spiral of wire or cylinder of metal gauze, now called the *grid*, between the filament and the cylinder or plate forming the anode, we came into possession of an appliance of remarkable utility. So much has been already written and said on the subject of the thermionic valve that the elementary principles may be assumed to be well known.

---

[*] Lecture delivered before the Institution of Electrical Engineers to whom we are indebted for the illustrations.

[*] See British Patent Specification No. 24850, 16th November, 1904, page 3, line 46, where occur the words : "As a very high vacuum should be obtained in the bulb and as a considerable quantity of air is occluded in the conductors, these should be heated when the bulb is being exhausted."

[†] See *Proceedings of the Royal Society*, 1905, vol. 74, p. 470.

When a difference of potential with the anode positive is created between the anode and the filament by a battery placed in the external circuit connecting them, a stream of electrons called the plate current flows from the filament to the plate. If we give to the grid various potentials relatively to the filament, the plate current is increased when the grid is positive and decreased when it is negative.

(To be continued.)

Questions and Answers by Practical Men.

RULES.

QUESTIONS : *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS : *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

Commencing with Question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION No. 177.

I am in charge of a large D.C. motor plant, and I wish to design a starter that will start, in case of emergency, any motor from 5 h.p. to 75 h.p. Can any reader give me some helpful suggestions which can be embodied in the design?—"TESTER."

QUESTION No. 178.

When working a cinema projector on 200 volts 50 cycles, with a three-bladed shutter, an intermittent light was produced on the screen. By using a single-bladed shutter this was eliminated. Can any reader explain this to me?—"OPERATOR."

[*Replies to Questions Nos.* 177 *and* 178 *must be received not later than March* 29, 1924.]

Answers to Questions.

QUESTION No. 172.

Can any reader give working details of the method of producing power by means of motor generators for motion picture work? I require 75 amperes at 75 volts.—"CINEMA OPERATOR."

REPLIES TO QUESTION No. 172.

The first prize (10s.) has been awarded to "D. J. Wilson," for the following reply :—

It can hardly be said that motor generators produce power. Motor generators are used in cinematograph halls for (1) the conversion of an A.C. supply into a D.C. supply; (2) transforming the voltage of a D.C. supply.

That there are more efficient methods is well known, and, owing to the fact that the motor generator requires little in the way of skilled attention, it is used extensively for small units.

It is essentially, as its name suggests, a motor and a generator, and these are often direct-coupled upon one bedplate; the can, however, be belt or rope driven should this be desired. In the case of the supply being D.C., a single-fed, double-commutating machine is often used. The armature of these machines have two windings, connected to which are two commutators, the field being common to both windings.

The induction-motor generator is for use on an A.C. supply, its disadvantages being: (*a*) Lower efficiency than rotary or motor converter; (*b*) lagging power factor; which are not as serious as they might be if the sets were large and in use night and day, since the advantages are :—

(*a*) Self-starting, i.e., without a starting motor.
(*b*) Reliability.
(*c*) Simple control gear.
(*d*) Freedom from hunting.
(*e*) Close regulation on D.C. side.

Concerning the generator, if this be required to supply a single bioscope lamp, a constant-current machine with a slightly drooping voltage curve will be required; but, if more than one bioscope lamp is required at the same time, then the machine must be of the constant-voltage type.

If the generator be driven by a single-phase A.C. motor, then the motor must be capable of withstanding an overload of 50 per cent. for, say, thirty seconds without falling out of step.

It is proposed to describe a motor generator suitable for converting three-phase A.C. (medium voltage) to D.C. at 75 volts.

$$\text{Output of generator in k.w.} = \frac{\text{volts} \times \text{amps}}{1{,}000} = \frac{75 \times 75}{1{,}000}$$
$$= 5.623 \text{ kw., say 6 kw.}$$

Assuming the generator efficiency to be 75 per cent., then,

$$\text{Output of motor to drive generator} = \text{horse-power output of generator} \times \frac{100}{75}.$$

$$= \frac{6{,}000}{746} \times \frac{100}{75} = \frac{2{,}000 \times 4}{746} = \frac{8{,}000}{746}$$
$$= 10.75, \text{ say 11 B.H.P.}$$

If the motor has an efficiency of, say, 80 per cent., then the combined overall efficiency will be

$$\frac{75}{100} \times \frac{80}{100} \times \frac{100}{1} = \frac{75 \times 80}{100} = 60\%$$

As the unit is small, it is proposed to use a squirrel-cage motor, with control gear as follows:—

The incoming mains should be brought to a small switchboard, to which should be fitted voltmeter, ammeter, integrating watt-hour meter, isolating switch or links, and fuses. The next panel in the board would be an auto-transformer starting panel, fitted with three-pole oil-break switch, which is fitted with overload release coils with time lags, and no-volt release coil, connected to an oil-immersed auto-transformer.

The D.C. switchboard must not be a continuation of the A.C. board, and should preferably be at the other side of the room, the panel being mounted with one D.P. quick-break knife switch, two fuses, shunt rheo., shunted ammeter, voltmeter, and two test lamps.

The two test lamps are to form the earth testing set. They are to be of the full circuit voltage, connected in series with the mid-point earthed. Normally they will glow with equal brilliance, and on the appearance of a leakage to earth one will be brighter than the other. A single-pole switch is fitted to control each lamp.

The starting will be exceedingly simple, and should present no difficulties. The same applies to the D.C. side, the voltage being regulated by the shunt rheo. in the usual manner.

If a suitable girder be built in the walls during erection it will prove exceedingly useful for lifting purposes when the set is under repair.—"D. J. WILSON."

The second prize (5s.) has been awarded to "E. M. F." for the following reply:—

I presume that in his question "Cinema Operator" has used the term "motor generator" in its widest sense, to cover any of the various kinds of rotating machines used for reducing a public supply voltage down to a value suitable for serving a cinematograph arc lamp, because some of these machines are not, strictly speaking, motor generators.

The machines can be divided into two main classes:—

(1) Those which convert a comparatively high voltage direct-current supply to a direct-current supply at a lower voltage which will be suitable for use with the arc lamp.

(2) Those which convert an alternating-current supply to a direct-current supply at a voltage suitable for the arc lamp.

Under (1) there are three distinct kinds of machine in general use. They are:—

(1*a*) The pure motor generator.—This consists of two machines, entirely separate electrically, but mounted on a common bedplate and with their shafts mechanically coupled.

One machine is a direct-current electric motor, usually shunt wound, taking its current from the supply authorities' mains, and driving the other machine, which is a generator, also generally shunt wound.

The generator is designed to give sufficient current for the arc lamp at a suitable pressure, in this case 75 amps. at 75 volts, and a regulator is inserted in the shunt field circuit to give a variation in voltage which will be found necessary in practice.

(1*b*) The D.C. motor converter.—This is a direct-current machine with one field system, one armature and two commutators.

There are two separate and distinct windings on the armature, one suited to the incoming supply pressure and the other suitable for giving a current and voltage suitable for the arc lamp.

The machine is in effect a D.C. shunt-wound motor with a second winding on the armature which functions as a generator winding, whilst the shunt field excited from the supply mains is common to both windings.

The machine is started in the same manner as an ordinary shunt wound D.C. motor, and voltage adjustment is made by means of a rheostatic regulator inserted in the field circuit.

(1*c*) The Crompton motor converter.—This machine has one field system, one armature, one commutator and two sets of brushes.

One set of brushes, which might be called the motor brushes, are used to convey current from the supply system to the armature.

Now, there will be a point or points somewhere on the commutator where a voltage suitable for the arc lamp will be found. It is at these points where the second set of brushes is placed. It would not be feasible with the ordinary commercial motor to place a second set of brushes on the commutator and collect a current of a different voltage to the input voltage, because of commutation troubles. In the Crompton motor converter, however, the pole pieces of the field magnets are specially shaped in order to render commutation possible under the special conditions which exist.

The machine is started in the same manner as a shunt-wound motor, and voltage may be regulated in just the same way as with (1*b*).

Of the three foregoing machines the pure motor generator is the simplest to deal with when a fault arises, but it is costlier in the first place, takes up more space, and is heavier than the others. Also it has a poorer overall efficiency, and consequently takes more energy from the supply mains for a given output than the others.

Turning now to class (2), there is only the pure motor generator to be considered, there being no other kind of machine commercially possible, at present, for cinema work. The motor is generally of the squirrel-cage type and the method of starting will depend upon whether the system is single, two or three-phase.

For single-phase circuits the starter will be quite special and will depend upon the design of motor, hence it is wise to purchase it from the motor maker. There is usually some kind of phase-splitting device provided in order to create a rotating field.

For two-phase a series parallel starter is quite suitable, whilst a star delta starter is often used for three-phase circuits, or in cases where the supply authorities will allow it, these motors may be switched directly on to the line without a special starting device.

As in the case of (1*a*), the squirrel-cage motor is directly coupled to a D.C. generator, generally shunt wound, and voltage regulation is obtained by means of a rheostat inserted in the shunt field circuit.

When a machine is being purchased it is well to remember that it should be capable of giving an output greater than the amount of energy required by one lamp only, because most cinemas have two or more projectors, and a second lamp may be switched on for trial or warming-up purposes whilst the machine is already delivering current to the lamp which is, at the moment, in full use.

"E. M. F."

"STORAGE BATTERY TROUBLES."

At the meeting of the Informal Section of the I.E.E. on Monday, Feb. 4, Mr. A. F. Harmer was in the chair, when Mr. F. W. Crawter opened a discussion on this very interesting subject. The opener had brought a number of lantern slides showing types of cells and the construction of the plates in various stages. He reviewed the preparation of the battery and the chemical changes under charge and discharge. He explained the scrupulous care taken in the manufacture of a first-class storage battery, and claimed that the average engineer and battery owner has a mechanical rather than a chemical view of his battery, and the troubles are mainly due to mishandling. He urged that expert advice be taken directly unusual symptoms occur.

Mr. W. R. Rawlings expressed his appeciation of Mr. Crawter's interesting address. He wanted to know what caused a plate to buckle—and why does one cell in a battery give out? In his experience, a slower rate of charge seems to ensure a longer life for the battery.

Mr. J. W. Beck seemed to have the judgment of the meeting with him when he said that if a battery be rated at 100, 99 per cent. of its utility would depend on treatment. In spite of the clearest directions from the makers, the mortality among batteries is very much greater than it should be. He knew of electricity works run on the most rigidly economical lines where the storage batteries were charged in the most extravagant manner. There are too many places where a few amperes to spare on the bars mean that the poor old battery has to undergo forcible feeding, and he knew of stations where every shift engineer as he comes on duty, promptly puts the battery on charge.

Mr. J. R. Bedford said he believed the G.P.O. reckoned the life of a telephone battery at about 150 cycles of charge and discharge. Mr. Crawter had pointed with pride to a battery which was in service after 4,000 cycles. What did he think was a fair life?

Mr. F. C. Raphael said that, broadly speaking, a maker's instructions were: Charge a battery, then discharge it right down. Don't overcharge it, nor charge for too long. Don't undercharge it. Charge it every day. Why? These instructions are not always consistent and are certainly not suitable to the conditions under which an ordinary house battery is installed.

Messrs. W. R. Cooper, A. F. Harmer, A. G. Hilling, R. V. Hook, W. A. Ritchie and F. Sclater also spoke, and Mr. Crawter summed up the discussion. He said to ask why plates buckle is rather like asking what people die of. If you lick a stamp on one side, it curls; if you wet both sides, it doesn't. Individual cells fail because the strength of a chain is in its weakest link. A cell may be situated where it gets a draught that carries impurities to it. In regard to a maker's card of instructions, this is a point of extreme difficulty. It is beyond human power to put in print instructions capable of only one interpretation, and a battery attendant is often unequal to appreciating these directions. The practice of putting a film of oil on top of the cell acid to prevent spraying is quite sound, but it collects dirt, which looks ugly. Further, if you want to take the plates out, the oil is in the way.

Reviews of Books, &c.

[Books noticed in this column will be sent from Electricity *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

Engineering Drawing. By H. H. Jordan, B.Sc., and R. P. Hochscher, B.Sc. (Chapman and Hall, 15s. net.)—The authors of this excellent book are the head professors of the department of General Engineering Drawing at the University of Illinois, and they have combined to produce a complete work containing all known information on the subject in a manner best calculated to meet the requirements of the engineering profession and others desirous of perfecting themselves in the technics of the graphical language.

The chief charm in this book is that it is suitable for both the beginner and the chief draughtsman of a large drawing office. It is, in fact, almost an encyclopædia on the subject, and could well be taken as a standard text-book by students at engineering colleges. Commencing with a chapter on the different styles of lettering suitable for drawings, it then deals with titles and methods of balancing and building a drawing.

The subject of projections and planes is thoroughly explained, followed by an excellent chapter on working drawings. Isometric and oblique projection is next dealt with, and the chapter on shop terms and processes followed up by one on technical sketching. Charts and diagrams are fully dealt with, and there is an excellent chapter on map drawing. Architectural drawing is well described, and also structural drawing. This chapter on structural drawng includes a list of structural engineering terms and details of standard beam connections and lay-outs of joints and trusses. A final chapter is devoted to patent office drawings and their requirements, and also two pages of symbols. The forty pages of appendix include geometrical constructions, topographical symbols, electric wiring, and heating and ventilating symbols and tables of thread, screws, rivets and metal gauge dimensions.

Well indexed, of nice paper and beautifully printed, the book is an asset to any engineer's library and one that he would always find of interest and use, as it not only deals with what is the correct practice in producing drawings of all forms, but describes, with the help of many excellent illustrations, the methods of procedure.

Electrical Trades Directory and Handbook, 1924. (Benn, 25s. net.)—Our big blue friend has just made his forty-second annual bow to the electrical industry, and his corpulent form has been received with the usual smiling welcome, for the simple reason that his sterling value is so well known to all in this office as a really invaluable work of reference. It contains the revised cinematograph regulations of the Home Office, details concerning the latest broadcasting licences and conditions, certain new regulations of the Electricity Commissioners, and heaps of other useful data of direct importance to all sections of the electrical trade, as well as the carefully revised alphabetical and classified directory. And all for twenty-five bob! It is honestly worth a lot more. So that's that.

MECHANICAL WORLD ELECTRICAL POCKET BOOK, 1924. (Manchester, Emmott, 1s. 6d. net.)—This useful handbook has, as usual, been carefully revised, a lengthy section on testing sets having been added, while the chapter on accumulators has been rewritten in accordance with the latest developments. Other items which have received attention are illumination, electricity in ships, electric welding and electric furnaces. The new edition is, therefore, certain to be appreciated by its many readers.

WILLING'S PRESS GUIDE, 1924. (Jas. Willing, Ltd., 2s. 6d. net.)—We welcome the 51st annual issue of this old friend. The writer has known and used it for more than thirty out of the fifty-one years, and has ever found it a work which is wonderful for quick reference as well as accurate and up to date, so it may be said to rest on a sure foundation, and is likely to continue sturdy expansion as time rolls steadily on. We can most cordially recommend it to the publicity managers of all the electrical undertakings in the kingdom.

THE N.A.S.E. DINNER.

The annual dinner and musical evening of the National Association of Supervising Electricians was held on Saturday last, the 16th inst., at the Holborn Restaurant, when Mr. W. E. Highfield, M.I.E.E., who is the president of the Association, welcomed a very large number of members, as well as a goodly sprinkling of distinguished visitors, including Dr. Alex. Russell, president, and Mr. Frank B. Gill and Mr. J. S. Highfield, two of the past presidents of the Institution of Electrical Engineers. The dinner was excellent, and the musical programme was also first class. Indeed, the concert part of the evening represented far more time than the speech making, and this was, we think, appreciated fully by all who were present. Dr. Russell, who proposed the toast of "The President and the Association," spoke highly of its activities, and the way in which it had developed during the nine years which had passed since its foundation. He also spoke in praise of its endeavours to promote harmony in the various branches of electrical work, with which its members were associated, and concluded with some very eulogistic remarks on the President, which, it is needless to say, were received with much applause. In his reply Mr. Highfield expressed his thanks for the way in which the toast had been received, and then went on to say how much he was indebted to the Secretary and the members of the management committee for the hard work they had put into the association in order to built it up to its present successful positon, in which it was showing a steady increase of membership and utility year by year. He was also very proud indeed to think that the qualifications for membership meant that only men of real ability were joining, and that, of course, was to the whole good of the industry. He referred to the pleasure that was felt in the presence among them of Dr. Russell and two other past presidents of the Institution. Mr. J. S. Highfield proposed the toast of "The Visitors and the Press" in a very humorous speech, in which he made various chaffing references to the misdeeds or the errors of omission and commission on the part of Mr. Brammer, the secretary, and then went on to speak of the gentlemen with whom the toast was associated, namely, Mr. Frank Gill, past president I.E.E., and Mr. A. H. Allen, of the *Electrical Review,* both of whom responded in suitable terms. The proceedings wound up at a late hour with "God Save the King" and "Auld Lang Syne," and everybody went away feeling that the evening had been a very happy one. In fact, even Mr. Brammer seemed to have a cheerful smile, in spite of the chaffing to which he had been subject in the course of the speeches.

Various Items.

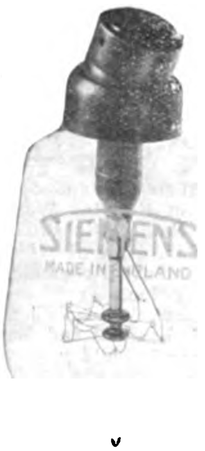
West of Scotland Electricity District.—The Electricity Commissioners will hold a local inquiry in the Justiciary Buildings, Jail Square, Glasgow, on Tuesday, March 11, at 10.30 a.m., and following days, with reference to the area to be included in the proposed district

Exhibition—A Railways and Docks Engineering Exhibition will be held at the Royal Agricultural Hall from July 30 to August 16. This is certain to be visited by a very large number of people who will be coming to London in order to visit the great exhibition at Wembley, and it should therefore appeal as a good medium for firms who specialise in the particular trades covered by the title. Full particulars may be obtained from the agents at 22/24, Great Portland Street, London, W.1.

Meetings.—There will be a meeting of the members of the Birmingham and District Electric Club at the Grand Hotel, Colmore Road, to-night, Friday, the 22nd inst., at 7 p.m., when Mr. H. E. Humphries (of Siemens, Woolwich) will deliver a lecture on Automatic Telephony, to be illustrated by lantern slides and explained by means of a working model.——The annual dinner of the Club will be held at the Grand Hotel on Friday, February 29, the President, Mr. W. Shaw, taking the chair at 7 p.m. Morning dress. Tickets 10s. 6d. each, from Mr. N. Deykin, 193, Station Road, Wylde Green.

Broadcasting in the Theatre.—Seatholders in the gallery and balcony at the Winter Garden Theatre are now, thanks to the enterprise of the management, entertained for the period before the curtain rises. Arrangements have been made with the G.E. Co., Ltd., for a "Gecophone" wireless set and two loudspeakers, which have been installed in the auditorium, in order to reproduce between the hours of 7 p.m. and 8 p.m., the concert broadcast from 2LO, the London station of the British Broadcasting Co., Ltd. For this purpose the gallery and balcony queue have been abolished, the public being admitted at 6.45 p.m.

Biff!—Annexed is an illustration of a Siemens lamp which has evidently been in the wars, but is still going strong. It was returned to Messrs. Siemens by an official of one of the largest electric tramway companies in London, with a note to the effect that "over four months ago it was put into one of our traffic offices, and two days after received a hit on the pip with a pair of steps, which knocked it into this shape, and it has burnt ever since, and still will."



Tenders Accepted.—The Admiralty have accepted the tender of Siemens Lamp Co., Ltd., for the supply of a large quantity of Siemens helical traction lamps for immediate delivery.——The G.E. Co. have received an Admiralty part contract for the supply of metal filament traction type lamps.

Tenders Accepted.—The G.S. and W. Ry. Co., Ireland, have accepted the tender of the G.E. Co., Ltd., for the supply of electric lamps for a period of five months, commencing with the 1st inst.

Meetings.—The I.E.E. will meet on Thursday, the 28th inst., at 6 p.m. Paper: "The Design of Apparatus for the Protection of Alternating-current Circuits," by A. S. FitzGerald, Assoc. Mem.

Palestine.—The Director of Public Works, Russian Buildings, Jerusalem, desires to receive regularly from manufacturers, catalogues, price lists, and other advertising literature concerning all kinds of electricity supply plant and apparatus

I.E.E. Smoker.—The fifth smoking concert of the informal meetings section of the I.E.E. will be held at the Engineers' Club on Monday next, the 25th inst., at 7.30 p.m. Colonel T. F. Purves, O.B.E., will be in the chair, and the musical programme has been arranged by Mr. J F. Avila.

I.E.E. Special Meeting.—A special general meeting of the corporate members of the Institution of Electrical Engineers will be held in the Lecture Theatre of the Institution on Thursday, 28th inst., at 5.30 p.m., to consider a resolution substituting new wording for By-law No. 9 in order to define clearly the use of the word "chartered" by the members of the Institution.

Metric System in Russia.—The Russian authorities have decided to introduce the metric system of weights and measures throughout Russia in private commercial enterprise, and the date fixed for the application of this regulation to electrotechnical goods was January 1, since which date the metric unit has become compulsory in this particular industry.

Finance.—The report of the Clyde Valley E.P. Co. for 1923 shows a total available profit of over £239,000, and the directors recommend a dividend on the ordinary shares equivalent to 8 per cent. per annum. They also transfer £70,000 to the contingency fund and write off various other items, leaving nearly £30,000 to be carried forward. Altogether a very satisfactory balance sheet.

The Junior Inst. of Engineers.—On Saturday, the 23rd inst., at 2 o'clock, members of this Institution will visit the British Empire Exhibition construction at Wembley, to inspect the railway of Never-Stop Transit, Ltd., in course of erection. On Friday, the 29th inst., there will be a meeting at 39, Victoria St., at 7.30 p.m. Lecturette, "The Manufacture of the Incandescent Electric Lamp," by W A. Rhind, M.I.S.I. (Member).

Plant Wanted.—The N.S.W. Govt. Rys. and Tys. invite tenders for the erection of an electric overhead travelling crane. The contract includes the maintenance of the whole equipment for a period of six calendar months after it has been taken over for regular service.——The Victorian Govt. Rys. invite tenders for the supply of metal and carbon filament lamps for the lighting of electric trains. Specifications, etc., at the D O.T. (Room 52), 35, Old Queen Street, S.W.1.

Pulverised Fuel Plants in France.—The Union d'Electricité which has power stations at Gennevilliers and Vitry, near Paris, for the supply of electric power to the city and its environs, has placed another large order for pulverised fuel plant with the company associated with Vickers and International Combustion Engineering, Ltd., of London. It is for the power station at Gennevilliers, which is now worked with B. and W. and Stirling boilers having multiple-retort and chain-grate stokers. For the new extension the engineers of the Union d'Electricité have decided upon Ladd-Belleville boilers and Lopulco plant for pulverised fuel firing, and this decision is significant, in view of the fact that the mechanical stokers already working in the station represent the very last word in modern practice.

Leaflets 77B and 95 have just been issued by **Gent and Co.. Ltd.**, of Faraday Works, Leicester, and deal respectively with their Radiomatic Broadcast Receivers and the Tangent Loud Speaker, both of which hold high reputations for quality of manufacture, combined with clearness of reception and enunciation.

A new electric bell accessory list has been issued by **Messrs. D. H. Bonnella and Son, Ltd.**, of 58, Mortimer Street, London, W.1, and should prove of value to all bell fitters and installation contractors. It is well illustrated and gives details of pushes, bells, buzzers, relays, indicators, and medical coils of all types and sizes.

Trade Notes.

Catalogue S7224 from the **Foster Engineering Co. Ltd.**, of Morden Works, Wimbledon, gives the latest reduced prices of the company's Apex "Quick Make and Break" switches of various types, as well as of sealing boxes and glands for armoured cable, together with some useful tables showing the wiring capacity of conduit for V.I.R. cables, wiring tables for motors, etc. It will, therefore, appeal to all installation contractors.

List No. 501, issued by **Messrs. George Ellison**, the well-known makers of electric control gear, of Perry Barr, Birmingham, gives illustrations and clear details of their latest type of hand operated 6,600-volt free handle oil breakers in steel frame cubicles, which have been designed to occupy the minimum floor space and to ensure the maximum of safety and reliability. They will, therefore, prove of direct interest to all central station engineers, as well as to engineers in charge of heavy electrical plant and machinery in shipyards, mills, factories, etc.

Catalogue No. 92, dealing with "Xcel" electrical domestic appliances, has just been issued by the **Siemens and English Electric Lamp Co., Ltd.**, of 38/39, Upper Thames Street, London, E.C.4. It is a neat and well illustrated list of 32 pages and gives details of many excellent and eminently useful household appliances which are being marketed by Messrs. Siemens under the above standard trade mark. It should therefore appeal to all installation contractors and retailers in electrical goods generally, and application should be made for copies by all in the trade.

Publication No. 2,311, from **Crossley Bros., Ltd.**, of Manchester, asks a pertinent question, namely, "Are you wasting money on your power costs?" and does its best to explain the advantages of the cheap power which is now obtainable from the Crossley Cold Starting Oil Engine. It should therefore interest all installation engineers and contractors.

A neatly bound and eminently serviceable day-to-the-page vest pocket diary has been received from **Mr. B. T. King**, the well-known patent agent, of 146a, Queen Victoria Street, London, E.C.4. Readers who are equally fortunate are sure to give it a ready welcome.

We have received a copy of the twenty-fifth anniversary issue of "Organisation," which is the house publication of the **Stolzenberg Patent File Co., Ltd.** It contains an interesting article dealing with the period 1899-1924, describing the growth of the company's system during that period, as well as giving illustrations of their manufactures. It should therefore be of direct interest to all who appreciate order and system in regard to the filing of business letters

GRINDERS
DRILLS
"DEPENDABLE"
& POLISHING LATHES
MARRYAT & PLACE, ENGINEERS.
28 HATTON GARDEN, E.C.2.

Sample Pair Sent on Approval for 8/6

Made of Pure Para Rubber,
soft and durable and unaffected by climatic condition.
DAVID MOSELEY & SONS
Limited.
ARDWICK MANCHESTER

MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
A PRACTICAL TRADE JOURNAL

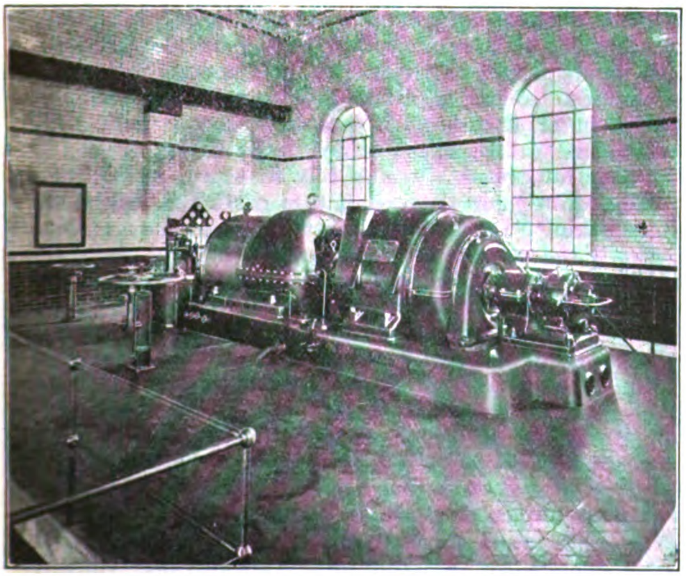
FEBRUARY 29, 1924.

CONTENTS. PAGE

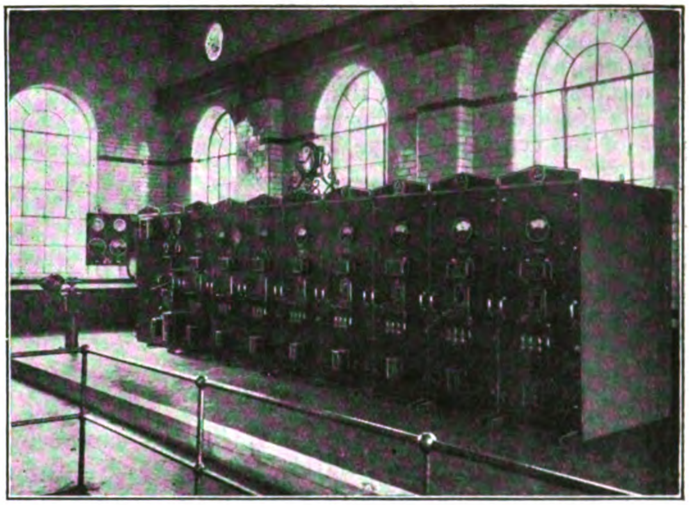
New Power-House at Whitwood Collieries 107
The C.T.S. Competition 108
The Lighting of Trains, Tramcars and 'Buses 109
Electrical Developments in France 110
Current Topics 113
The Electrical Wholesalers' Federation 114
Electrification of the French Midi Railway 115
British Industries Fair, 1924 116
An Accumulator Charging Cut-Out 116
The Institution Dinner 116
Problems in Telephony, Solved and Unsolved 119
Birmingham and District Electric Club 120
Various Items 120

NEW POWER-HOUSE AT WHITWOOD COLLIERIES.

Last month a new power-house was placed in commission at the Whitwood Collieries, near Normanton, owned by Messrs. Henry Briggs, Son and Co., Ltd., who are also the owners of Silkstone and Haigh Moor, Saville, Water Haigh and Syndale pits in the district, and work some of the best seams of coals in West Yorkshire. The new power-house will serve as a central generating station for supplying power to these pits. As yet it contains only one generating set, but provision has been made for additional plant as it becomes necessary. At present there is a 2,000 k.v.a. 3-phase G.E.C. F. and C. turbo-alternator, a 500 kw. rotary converter, a transformer, a ten-panel truck-type cubicle alternating-current switchboard, and a direct-current switchboard consisting of rotary converter and feeder panels. Mr. John Bentham, M.I.A.Min.E.E., of Stonleigh Lodge, Agbrigg, Wakefield, was the consulting engineer responsible for the scheme, and the contract for this equipment was placed with the General Electric Co. It is interesting to note that electricity has been used at these pits for many years, the original installation consisting of four 112 kw. open type G.E.C. direct-current generators driven by Crossley gas-engines, and a 200-kw. E.C.C. Kynoch set.



2,000 K.V.A. 3-PHASE G.E.C.-FRASER AND CHALMERS TURBO-ALTERNATOR.
3,300 volts, 50 cycles, 3,000 r.p.m.



G.E.C. 10-PANEL TRUCK-TYPE CUBICLE SWITCHBOARD.

The general outline of the new scheme is that the power generated by the alternator is fed to the busbars of the truck-type cubicle switchboard. Thence it is distributed, first, to the transformer for supplying the 500-kw. rotary converter; and, secondly, for transmission by means of overhead lines to the various outlying pits. The motor driving the condenser is fed through a step-down transformer connected directly to the alternator terminals, so as to avoid the closing down of the condenser in case the main breaker trips. The power from the rotary converter, the direct-current voltage of which is 220/230, is used for small motors on the surface and for lighting.

The turbine is a Fraser and Chalmers' standard mixed-pressure unit having a normal capacity of 1,500 kw. when running at a speed of 3,000 r.p.m. It is capable of carrying full load with low-pressure steam at 16 lb. per sq. in. absolute, with a 28.5 in. vacuum. When supplied with high-pressure steam at 150 lb. per sq. in. with 150 deg. Fah. super-heat, a maximum load of 1,875 kw. can be carried. For the time being the steam pressure is only 100 lb. per sq. in., and the turbine has therefore been specially designed to meet these conditions and to carry 1,500 kw. under this minimum steam pressure. It is of the impulse type, with one velocity stage and two Rateau stages in the high-pressure portion and five Rateau stages in the low-pressure portion. The rotor is of rigid design, its critical speed being well above the normal running speed, and a Mitchell thrust-bearing is arranged at the high-pressure end of the turbine to take up any thrust in the turbine rotor.

The safe arrangement in the turbine consists of an emergency governor of the plunger type mounted at the high-pressure end of the turbine shaft. In the event of the turbine assuming a speed of 10 per cent. in excess of the normal, the emergency governor automatically closes the stop valve by releasing the closing spring. Furthermore, the pressure oil supply to the relays is cut off, and the power cylinder connected to the drain, so that the high and low-pressure throttle-valves also shut instantaneously and automatically, being spring-controlled. In addition, the emergency governor operates a vacuum breaker connected to the exhaust of the turbine.

The condensing plant, supplied by Messrs. Cole, Marchant and Morley, Ltd., Bradford, is of the low-level jet type, designed to deal with 40,200 lb. of steam per hour with a vacuum of 28.5 in. The cooling water required by the extractors is taken from the injection water-pipe, so that an independent supply is only required for starting up. The extraction pump is of the centrifugal type, driven by a 72 h.p. motor at 720 r.p.m.

The alternator, which, as already stated, is rated at 2,000 k.v.a., runs at 3,000 r.p.m., generating a pressure of 3,300 volts 50 cycles. The machine embodies the usual features associated with high-speed electrical machinery, and is protected by the usual generator protective apparatus of the G.E.C. protection system (McColl patents).

The rotary converter is of the standard G.E.C. pattern, designed for reactance control, and is self-synchronising. This method of starting is extremely simple, and possesses certain important features, amongst which may be mentioned, first, the fact that the windings of the starting motor are not kept in circuit during running, external reactances being provided; and, secondly, it is impossible for the attendant to perform the necessary starting operations in any but the correct sequence.

The truck-type cubicle board embodies many features; it is safe, adaptable, economical in floor space and head room, accessible for inspection and cleaning, and the panels are interchangeable. The cubicles are constructed of steel plates. The truck consists of a stove-enamelled steel panel mounted on angle-iron framework. To the bottom angle-irons of the truck are fitted wheels with ball bearings to facilitate the movement of the truck when inserting it within or withdrawing it from the cubicle. Handles are provided at a convenient height on the front of the panel. The necessary measuring instruments, relays, etc., are mounted on the front of the panel, the oil switch, instrument transformers, isolating plug switches, etc., being mounted on the framework of the truck. Leakage protection is provided for each feeder circuit.

The busbars are contained in a compartment at the back of the cubicle, which is specially partitioned off. The plates which divide this busbar compartment from the main cubicle are drilled so as to allow the isolating plugs connected to the oil switch to pass through and make contact with terminals on the busbars and outgoing cable terminals. The plug contacts are self-aligning, being fixed in the vertical plane; in the horizontal plane contact is not impaired even if the trucks are out of line. In no case is it possible for the truck to be withdrawn and the oil switches closed, neither can the truck be inserted in the cubicle until the oil-switch handle is placed in the "off" position. Moreover, the current cannot be broken on the plug contacts, and, in addition, the truck is held mechanically in its cubicle directly the oil switch is closed. These factors of safety are made possible, first, by the use of a falling shutter plate, which uncovers the isolating-plug holes when the truck is pushed in; and lowers this shutter, completely covering up the plug holes, directly the truck has travelled a small distance when being pulled out. The other safety features are made possible by suitable mechanical interlocking devices.

THE C.T.S. COMPETITION.

We have now received from Mr. W. E. Highfield, as judge in this very interesting competition, full particulars of the papers to which he has awarded the prizes, and they will be reproduced in these columns in order of merit. The first prize, £5 5s., has been awarded to Mr. W. Ellerd-Styles, M.I.E.E., and Mr. Highfield criticises it thus:—

W. ELLERD-STYLES.

This paper is well put together, and is concise and to the point. The merits of the subject are well brought out and various special cases are shortly given. There is a good deal of information on the carrying out of the system, all of which is excellent.

The criticism is also carefully done and to the point. The paper merits the expression "Good," and is given 75 per cent.

The actual paper is as follows:—

C.T.S.: ITS ADVANTAGES AND DISADVANTAGES.

Standardisation tends to reduce the number of articles essential to the electrical engineer and contractor, but where cables are concerned we find it necessary to stock an infinite variety, to meet the needs of the user. This or that class of cable which is developed into a "wiring system," each has its own merit and demerit, and consequently it is desirable mainly to consider the *Class* which has the widest application. C.T.S. is easily first where adaptability is the keynote.

The durability of the covering is very marked, there is no creeping of moisture, it possesses great tensile strength, high resiliency and mechanical strength, it is unaffected by the usual chemical actions met with in practice. Being very flexible it is easy to manipulate. The outer sheathing is non-hygroscopic and, unlike standard V.I.R. cable, is not easily ignited.

One important advantage is that no special fittings are required for the installation of C.T.S. cable—that "earthing" and "continuity" are unknown factors surely relieves the user of much trouble and annoyance. Electrolysis and condensation cease to count as destructive factors.

For aircraft circuits there is no cable offering the advantages of C.T.S. Ordinary V.I.R. or workshop is entirely unsuitable in view of the strenuous duties entailed. Armoured wire is too heavy and requires considerable skill to handle, if short circuits are to be avoided. For automobiles it is most durable from the experience of the writer, covering a period of ten years. Most faults on car lighting equipment can be attributed to cable faults, seeing that a varied series of severe tests have to be withstood. Considerable vibration, heat from the engine and exhaust where the cable is fixed to the chassis and under the bonnet, oil and grease, as well as rough usage during overhauls. It makes the best flexible for portable apparatus such as hand-lamps, drills, vacuum cleaners, heaters, etc., also in the form of trailing cables for mines it more than holds its own.

It is for general lighting and power installations, however, where C.T.S. can be utilised indiscriminately. We all know troublesome situations that are severe on average wiring systems, stables, laundries, chemical works, are in this category. Corrosion has no terrors, and providing suitable fittings are adopted, the installation will stand up to the most severe test. The sheathing must, however, be continued well inside of all fittings, and the erector also must be careful with trims so as not to split the sheathing. Portland cement, Serapite or plaster of paris have no destructive effect on C.T.S., and it can, therefore, be buried in walls, ceilings or floors with the knowledge that no trouble will arise. Much is made of the advisability of using tubing or conduit to protect the cable in such situations. This is exaggerated, seeing that a facing of neat Portland cement will defy any nails that may be attempted to be driven into the location of the sunk cables. With runs under floors in the same direction as the joists, it is an easy matter to obtain fixings on the side of the joists. If taken across joists it is a sound procedure to drill holes with a ratchet brace about 3 in. from the top of the joist, which assures protection from nails and at the same time does not weaken the structure. In factory wiring and similar installations it is advisable to employ a short length of piping for down runs entering the floor, if wiring on the surface, but in most instances it will pay to sink the cable into the wall at such points and face over with neat cement.

In common with all surface wiring, if C.T.S. is employed, discrimination is necessary when grouping wires. Flat section makes the neatest job, but uniformity should be aimed at. There is nothing more unsightly than to see a flat twin or triple cable run alongside of a single-core cable. In such situations single-core cable gives the neatest effect if properly fixed. A judicious use of three- or four-plate ceiling roses would assure that, when dropping to switches, either twin or triple flat section cable could be employed, assuming one or two switches being required.

The disadvantage of C.T.S. is the earthing of motors, portable apparatus, etc., particularly when an efficient earthing point is some substantial distance from the apparatus to be earthed. For fixed wiring the neatest procedure is to run the earth wire behind the cleats supporting the cable. With portable apparatus, such as drills, grinders, etc., it is necessary to employ a cable having one of the cores as an earth wire.

Perhaps the greatest disadvantage is the fact that with C.T.S. wiring no special skill is required, and in consequence the standard of workmanship which is developed in the erector is much below what is required for most systems of wiring. Knowledge of circuits, neatness and careful preparation of cable ends, practically covers the workman's capacity. The skilful use of tools is an absent feature seeing that the kit comprises approximately a hammer, two screwdrivers, a pair of pliers, a plugging tool, bradawl or gimlet and a stick of Chatterton. However, this does not indicate that a C.T.S. job is not as good as any comparative system, though C.T.S. wiring is practically a one-man job.—W. ELLERD-STYLES, 91, Forest Drive West, Leytonstone, E.11.

THE LIGHTING OF TRAINS, TRAMCARS AND 'BUSES.

Some of the varied problems arising in the lighting of trains, trams and 'buses were discussed in a paper by Mr. J. F. Caine and Mr. E. A. Marx (junior) before the Illuminating Engineering Society, on February 19.

The authors referred to the question of vibration, and described the special forms of lamps designed for traction work. The task of the lamp-maker is not rendered easier by the fact that there is no standard voltage for lighting carriages, and from this standpoint the selection of the system and pressure in future main-line electrification is of considerable consequence. Yet another special circumstance is the variation in pressure when trains are accelerating. A fall in pressure of 35 per cent. causes a diminution in candlepower of 86 per cent., and such a pressure drop is by no means unusual on electrical railways.

In lighting railway carriages, and especially in tramcars and 'buses, limitations are imposed by the small headroom. The authors pointed out the drawbacks of conventional methods of using rows of unshaded lamps, which, being on a level with the eyes of persons standing, cause embarrassing glare. Another problem is the avoidance of head shadows and the provision of fairly uniform distribution of light. In saloon cars the provision of local lighting with portable shaded lamps at individual tables is satisfactory for reading, but supplementary general illumination from above is needed to prevent excessive contrast between the brightly lighted table and the relatively dark surroundings.

A new system illustrated by the authors makes use of pairs of 20-watt lamps, mounted in trough reflectors transmitting light through flashed opal glass. In all 920 watts are allotted to a coach, and the system is very pleasing and free from glare. With this arrangement an even illumination of 5 foot-candles was secured. It was pointed out that in practice there is no general agreement on a standard for carriage lighting. One finds values ranging from 1 to 3 foot-candles, but the latter figure is not often provided. In these days the illumination should be ample for reading and writing, and possibly also sewing and knitting. It must also be remembered that reading a book subject to considerable vibration is in itself a trying process. All things considered, the authors suggest that the illumination should be not less than 5 foot-candles.

Drivers' compartments and signal-boxes form a somewhat exceptional case. In such work, where clear vision into dark surroundings is essential, there should be practically no interior lighting, except, perhaps, subdued concealed lighting of dials of instruments. In this country, where railway tracks are fenced in and well guarded, powerful headlights are not needed.

In the concluding portion of the paper the authors referred to miscellaneous problems in railway lighting, such as the illumination of platforms, booking offices, station name-plates, etc. It was suggested that the minimum for terminal stations should be 2 foot-candles, for important junctions 1 foot-candle, while for wayside stations "beacon lighting," which gives no adequate illumination of platforms, should be superseded by adequate lighting, if necessary only turned on when trains are due. Station names should be illuminated by concealed lamps so as to stand out clearly, and good illumination is specially desirable for Customs examination—a lengthy process which is apt to be delayed by insufficient light. In conclusion it was urged that all lighting problems on a railway or system of trams and 'buses should be under the control of one expert, and that illumination should be considered at an early stage when improvements and extensions are undertaken.

An interesting discussion ensued, in which Mr. A. Cunnington (L. and S.W. Railway), Mr. Baker (Underground Railways), Mr. G. Campbell, Mr. L. E. Buckell, Mr. H. F. Troughton (M.E.T.), Mr. Moore and Mr. L. Gaster took part.

Mr. Gaster, who presided, referred to some of the work done by the joint committee of the Society appointed to inquire into railway lighting, and other speakers all agreed as to the importance of the subject and the variety of problems presented.

After Mr. A. E. Marx had briefly replied to the discussion, it was announced that the next meeting would be held on Friday, March 21, when there would be a discussion on "The Use of Light in Modern Advertising."

ELECTRICAL DEVELOPMENTS IN FRANCE.

At the meeting of the Informal Section of the I.E.E. on Monday, 18th inst., Mr. F. Gill was in the chair, when Mr. E. M. Malek opened a discussion on this subject. The opener said it was so large that he could only give a very general outline of the schemes, many of which were worth a long study by themselves. From time to time articles on French developments have appeared in the technical press, but they have given no definite idea of the courageous and far-sighted schemes which are in progress or are projected.

In France, co-operation and interlinking were not unknown, and the examples set by the companies in the Lyons area showed what could be done. Few people here were aware of what existed, and those who knew probably found out through becoming interested in the 100,000-volt D.C. system, on which Mr. J. S. Highfield read a paper some twelve months ago.

In 1906 the French Chamber passed a Bill dealing with electrical matters, and powers were given to the Ministry of Public Works to collect information and prepare schemes for the development of national water-powers. At the same time they were instructed to co-ordinate the efforts of public bodies and private companies, and a certain amount of progress was made. In 1902 only 200,000 h.p. had been harnessed. In 1906 this was increased to 350,000 h.p., and in 1919 1,500,000 was in operation. Much of this increase was in hand in 1914, and was completed with great advantage to the prosecution of the war.

In 1919 the precarious situation due to the French industrial area of the north-east and east being liable to feel the direct effects of the war, the fact of nearly all the French coalfields being in that area, and the transport difficulties aggravated by the necessity of importing fuel through the western and southern ports, turned what was an economic desirability into a national necessity.

This feature was recently touched on by M. Bachellery*, who compared the ease with which the electric railway services supplied from water-power were maintained in comparison with those sections of the Midi Railway dependent on steam locomotives. In 1919 reconstruction committees were formed, and a great programme was drawn up. Its basis had been studied for some time, and decisions were rapidly arrived at.

M. Le Trocquer, present Minister of Public Works, recently stated that France has 9,000,000 h.p. available from water-power. In 1919 1,500,000 h.p. was in use, by 1925 there will be 3,000,000 h.p. The Public Works Department is dealing with 200 applications for sites totalling 1,500,000 h.p., so that in ten years there should be 4,000,000 h.p. developed, representing a saving of 24,000,000 tons of coal per annum.

There are 82 power houses in France, having a capacity of over 10,000 kw.; of these ten are over 50,000, two of them over 100,000. Gennevilliers has 200,000, and will have 400,000 kw.

These stations are not inter-connected, but they will be, and will form part of a general distributing system into which all new stations will also feed their surplus energy.

The regions of hydraulic power are the east, centre and south. In these areas, and between them, a complete network of overhead lines is projected, and is being built on a predetermined plan. Apart from the inter-connection of these three areas, Paris will be connected to each, whilst the eastern area will also connect with the N.E. industrial area, which in turn will connect up to the towns on the north coast, Amiens and Rouen. Lines from the south-west and centre will feed the west coast and be continued into Brittany and Normandy, linking with Rouen and Caen, thus forming a ring main round France.

A company, called the Union Hydro-Electrique, has been formed to build a 50,000-kw. station at Eguzon sur la Creuse. At Chambon a plant of 150,000 h.p. will be installed, and the Union Hydro-Electrique, with the Associated P.O. Railway, will have between them 244,000 h.p. at work within the next two years.

In the Alpes Maritimes there are four schemes in hand, viz., Isere, 180,000 h.p.; Durance, 185,000 h.p.; Arc, 118,000 h.p.; Romanche, 75,000 h.p.

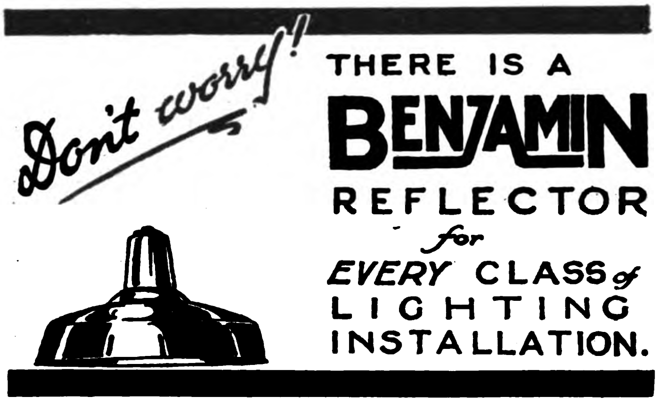
Hand in hand are bold projects for the canalisation and development of the French rivers and waterways. Mr. Malek believes that a considerable redistribution of the population is likely with very great growth in the metallurgical industry, and with consequent enormous reaction upon the rest of Europe.

In closing the discussion, Mr. F. Gill complimented the opener on his paper and its interest. He suggested that the Informal Meetings Committee should hold from time to time a discussion on electrical development in other countries.

A handsome poster of the B.T.-H. Radiola Wireless Sets has been issued by the **British Thomson-Houston Co., Ltd.**, of Mazda House, Upper Thames Street, and Rugby, and in view of the steady increase in the demand for wireless sets of really good and reliable quality we have no doubt that traders in these goods throughout the country will be pleased to have copies of these posters. They may be obtained on application to the company and should help to increase sales.

---

*See the paper now running in ELECTRICITY.



Don't worry! THERE IS A BENJAMIN REFLECTOR for EVERY CLASS of LIGHTING INSTALLATION.

Advert. of the Benjamin Electric Ltd., Brantwood Works, Tariff Road, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and Abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Tuesday morning, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

Profits.

Arising out of my comments last week on the prevailing high rates per unit charged for electrical energy, comes the reflection that a good deal of our present discontent and difficulty in making ends meet may be due to the setting of too high a margin of general profit on all essential commodities. During the war there was a general tendency to raise the average profit on practically every marketable commodity, it being argued, and with some degree of truth under the then conditions, that traders could no longer carry on business on the margin of profit represented by conventional pre-war standards. Thus ten per cent. became fifteen or even twenty; twenty merged into thirty-three and a third; whilst those pre-war profiteers who had been extracting a generous twenty-five per cent. or more out of their trading transactions, promptly concluded that they would go bankrupt within a week on less than forty per cent. clear profit.

Although the war has been over some five years, we still think and calculate in terms of the abnormal conditions then prevailing, and if a general analysis could be prepared, showing the comparative working profits in various trades and industries before and since the war, I believe that it would show that, generally speaking, the average profit of to-day is far ahead of that which ruled prior to 1914. When it is only reckoned once, as in the case of a direct transaction between producer and consumer, this general raising of the profit margin makes a quite considerable difference in the cost of the commodity affected, but, when, as is the case in the majority of businesses, intermediate profits are taken by all sorts and conditions of traders, who constitute the connecting links between the factory and the consumer, the higher profit ratio bulks large, and may in extreme cases totally obscure the original net factory cost of the article.

Sir Henry Whitehead, President of the Bradford Chamber of Commerce, recently drew attention to the marked difference between the wholesale and retail costs of living, and expressed the opinion that the cost of living could still be considerably reduced. The difference between what the manufacturer received and the price paid by the consumer was altogether too high. If the principle of small profits and a large turnover were again adopted he was confident that we should have less unemployment. Another public speaker, a prominent member of the present Government, expressed the opinion the other day that the ratio of non-producers to producers in this country was inordinately high and called for investigation. In other words, the existing system of distribution, with its thousands of middlemen, doing little or nothing to justify their existence, and in some cases not even handling the goods in which they deal, is altogether too costly a burden for productive industry to carry.

It is an undoubted fact that the cost of getting certain commodities into the hands of the purchasing public through the medium of the distributing and sales system at present in vogue, amounts to a considerable percentage of the total cost, as represented by the retail price of the commodity, and it would surprise many people to learn the real net factory cost of some of the products in common use. I could cite an example, well-known to every reader, and which, retailing at one shilling and ninepence, could be made up at home by the consumer, from the simplest possible ingredients purchased at a cost of less than twopence. In this particular instance most of the balance of one shilling and sevenpence goes in advertising. There are many similar examples.

We seem to have jettisoned the old trading policy of small profits, quick returns, and to aim rather at large individual profits and limited turnover. It is an unsound policy, because the cheaper an article can be placed on the market the greater the number of people who can afford to purchase it, and, consequently, the greater the demand. With increasing demand, the cost of manufacture falls progressively, due to lowered factory costs incidental to mass production. Thus the smaller profit margin ultimately benefits everybody, producer, distributor, and consumer alike, and makes for improved trade all round. Large profits limit the spending power of the public, lessen demand, and generally conduce to such periods of trade depression as we have been, and still are, experiencing.

Rent Restrictions and Electrical Development.

The new Rent Restriction Bill, if it passes the third reading, should react favourably on the further development of electricity for domestic requirements. Many thousands of tenants, at present uncertain of their tenure, have hesitated and are still dubious as to the advisability of spending money on wiring and fitting their houses for electricity supply when it is on the cards that they may be turned out in a few months and the landlord reap the benefit of their enterprise. On reflection, there is little doubt that the housing problem and its uncertainties have reacted very unfavourably on domestic electrical development in the case of those houses not already equipped for electrical service. I am personally acquainted with several men who would gladly have incurred the expense of an installation had they been certain of their tenancy for a reasonable term of years.

Now that it is proposed to extend the protection to existing tenants for a further three years there is some inducement for these and other householders to incur the risk of losing their homes and instal electric light and other services, a fact which enterprising electrical contractors should not be slow to take advantage of. It is quite a good talking point for supply canvassers also, and these gentlemen, before approaching a householder on the subject of electricity supply, would be well advised to ascertain whether he is the owner or only occupier or tenant of the house he lives in. In the latter case insecurity of tenure no longer acts as a deterrent, and he may go ahead with his electrical installation with some confidence of being able to enjoy the resultant benefits.

Buy British Plant.

The decision of the Bradford Corporation to place a contract for four rotary converters with a Belgian firm, thus effecting a theoretical saving of some £4,000, the approximate difference between the equivalent British and Belgian tenders, has provoked considerable criticism and discussion. Under ordinary circumstances, and apart from vital questions of rates of exchange and unemployment at home, Bradford has every right to study the interest of its ratepayers by placing orders in the cheapest market. On the other hand, it is a moot question whether any contract placed abroad at the present time is really an economic proposition, however much it may appear so on the basis of pounds, shillings and pence. Along with other corporations, Bradford is no doubt contributing heavily in the way of local and Imperial taxation, and will doubtless have to spend far more than the trivial sum of £4,000 within the next twelve months to maintain the present level of doles to its local unemployed.

Admitting that the order for rotary converters, if placed in this country, would not necessarily have benefited local Bradford labour, it, nevertheless, represents the principle, so often disregarded, of supporting home industries, and, if every municipality in the country acted loyally up to this principle in placing essential contracts for plant and materials, the resultant benefit must inevitably be reflected in a general reduction of unemployment and a gradual diminution in the total amount distributed in doles. "Buy British Goods" is a slogan which should be before every British councillor serving on a committee with power to place contracts involving the expenditure of public money. There is ample competition within the country to ensure freedom from profiteering, and every penny spent here means a trifle less unemployment and discontent.

The Lighting of Trains, Trams and 'Buses.

The discussion on this subject before the Illuminating Engineering Society, on February 19, served to show how much has been achieved in this field during recent years, though it is also true that much remains to be done. In these days we are no longer content with a dim illumination just sufficient to enable fellow-passengers to be distinguished. Illumination in coaches should enable people to read and write, and possibly also to knit, in comfort. Companies will find that the public appreciate attention to their wants in this respect, and that badly lighted trains and vehicles are avoided in preference to well-illuminated routes. The subject presents many problems, chiefly arising from the low headroom, which necessitates special fittings. But the representative gathering of engineers concerned with railways, trams and 'buses who joined in the discussion shows that the need for good lighting is recognised, and I look forward to steady improvement.

The C.T.S. Competition.

In another part of this issue my readers will notice the first prize winning article in connection with this competition. It created quite a large amount of interest, not only among the readers of this paper, but also in the trade generally, and in view of the careful way in which the papers were judged by Mr. Highfield, I think Mr. Ellerd-Styles is to be congratulated on his success. Now I want to know if any reader can suggest some other competition which will appeal to my readers. Of course, it must not be a mere copy of the C.T.S. scheme, but something original and likely to appeal to them in a wide sense of the word. What about it? Don't all speak at once. A sound proposition will earn the sincere gratitude of

ELEKTRON.

THE ELECTRICAL WHOLESALERS' FEDERATION.

The annual luncheon of the members of this very enterprising association was held at the Hotel Russell on the 20th inst., with the president, Mr. G. Donovan, in the chair, supported by approximately sixty members and visitors. Mr. Donovan, in the course of his toast of "The Kindred Associations," extended a very hearty welcome to the gentlemen who represented them, commencing with Mr. Robson, of the E.C.A., whom he complimented on its trading policy. Suitable replies were given by Mr. Robson, Mr. Gimingham, who spoke for the Elma, and Mr. Dunlop, who acted in a double capacity in the absence through illness of Mr. Atkinson, of the C.M.A. Mr. Callow proposed the toast of "The Electrical Wholesalers' Federation," and Mr. Donovan replied, after which Mr. Beaver said nice things about the Press, and Mr. R. W. Hughman, of the *Electrical Times*, retaliated with the tale of the terrier in the trenches, which got absolutely fed up with rats. The luncheon was quite a happy little function, in which various speakers made suggestions for mutual forbearance and co-operation which should tend to benefit the industry as a whole, and a proposal that as this is British Empire Exhibition year, an endeavour should be made to sell British goods rather than foreign was received with marked approval by all present. After the luncheon there was an adjournment to hear Mr. Beauchamp expatiate on the glories of the E.D.A. exhibit at Wembley, in which we hope he obtained the strong support of the Federation.

ELECTRIFICATION OF THE FRENCH MIDI RAILWAY.*

By A. BACHELLERY, Ingénieur-en-Chef, Chemins de Fer du Midi, France.

(*Concluded from page 96.*)

It may now be asked what results, either economical or technical, the Midi Company has already obtained, or expects to obtain, through electrification of its lines?

Although electric traction is already in use on 140 miles of our lines, it is still too early for us to give figures as to its cost, as only 37 miles are established under standard conditions, whilst several hundreds of miles are under construction. Nevertheless, we may say that in many ways electrification has so far proved profitable.

Not only do drivers of electric locomotives get lower wages than steam locomotive engineers, but also their daily run is 30 per cent. longer, on account of less time being spent for engine-shed operations.

As to the machines themselves, worked by several drivers they cover daily about 2.5 times the distance covered by a steam engine, which more than compensates for their higher price.

Important economies are also realised on engine-shed and repair-shop expenses. Electric locomotives require much less labour for their maintenance than steam locomotives, a great many daily operations, such as coal and cinder handling, water pumping, tube blowing, boiler washing, etc., being entirely eliminated, whereas repairs are greatly simplified through the suppression of the boiler and much mechanism.

On the whole, and in spite of most of the electrification work having been done under very unfavourable price conditions, there is every reason to be confident that the operation will prove profitable.

A strong support to this belief is the rapid increase in traffic and revenue on our electrified lines, consequent on faster and more frequent trains. As a matter of fact, the technical advantages of electric traction are still more certain than the economical ones.

It allows, especially on mountain lines, a higher commercial speed. For instance, on our main line from Bayonne to Toulouse there is a grade of 1 in 30, 7½ miles long, which takes an express hauled by a steam locomotive 34 minutes to climb. The same train hauled by an electric machine gets to the top in 13 minutes.

On the Transpyrenean lines long grades of 4 per cent. will be mounted by passenger trains at a speed of 25 miles an hour, whereas it is doubtful whether steam engines could work any effective service on such a line.

Even on level lines train schedules can be made quicker, on account of a more regular and uniform speed being maintained by the electric locomotive, and of the suppression of those stops which are necessary only for taking in water. On the Bordeaux-Hendaye line, where the maximum grade is 1 in 200, our fastest train, the southern express, actually covers the 92 miles from Bordeaux to Dax in 1 hour and 49 minutes. With an electric locomotive it will run at an average speed of 65 miles, and gain about 25 minutes on the present schedule.

Trains can also be made more frequent without prohibitive cost. During the war, when the strictest economy prevailed and the daily number of trains was reduced on a great many of our lines to two in each direction, the Midi Company could always maintain without extra expense four or five trains in each direction on the electrified lines. The present programme is to establish around the company's mountain or seaside resorts a service of light and frequent trains very similar to the suburban service, and this can only be accomplished by electric traction.

It is, perhaps, useless to say that from the traveller's point of view the suppression of smoke and cinders is also a great improvement. This is particularly the case with lines such as the Transpyrenean running through tunnels several miles long.

Electric traction will also prevent the costly forest fires which are started too often by locomotive sparks in the forest properties along the railway.

One of the greatest advantages, however, to be found in railway electrification as carried out in France is the construction of a close network of electric transmission lines. Extensive areas are mostly agricultural and only to a small extent industrial. In such districts the demand for electrical energy could scarcely be sufficient to justify the high expense involved in long transmission lines. On the other hand, a great many railway lines, on account of limited traffic, require only a small proportion of the current which the high-tension wires can carry, and this condition in general corresponds to cases where electrification could not be economical. In many cases the combination of these two unprofitable operations makes a profitable one, and the result will be not only to improve railway service considerably, but also to bring cheap electric current to every town and to a large number of small localities. While our 150,000-volt main transmission lines supply large centres such as Bordeaux and Toulouse, the 60,000-volt wires that follow the railway everywhere and feed step-down transformers in sub-stations spaced some 15 miles apart, will leave but little to do in order to build distribution systems covering the whole country.

When this is done on the 2,000 miles of road that the Midi Company intends to electrify, and when the Paris-Lyons-Mediterranean and Paris-Orleans companies have on their side electrified some 3,800 miles in accordance with a similar plan, and when the latter company has constructed the 300-mile 150,000-volt line from the Dordogne power plants to Paris, then not only railway electrification, but also public and industrial electrification will have made a decided advance in France.

Meetings.—A Wireless Section meeting of the I.E.E. will be held on Wednesday, March 5, at 6 p.m. Paper: "Development of the Bellini-Tosi System of Direction-finding in the British Mercantile Marine," by Comdr. J. A. Slee, C.B.E., R.N. (Ret.). Member.——The Junior Inst. will meet to-night (Friday), the 29th inst. Lecturette, "The Manufacture of the Incandescent Electric Lamp," by W. A. Rhind. Also on Friday, March 7, lecturette, "An Introduction to the Study of Fire Danger in Factories, with Some Notes on Fire Insurance," by P. M. Fraser; and on Friday, March 14, paper, "Water Tube Boilers," by L. M Jockel. All at 7.30 p.m., at 39, Victoria St.

---

* Paper read before the I.E.E. on November 22, 1923

BRITISH INDUSTRIES FAIR, 1924.

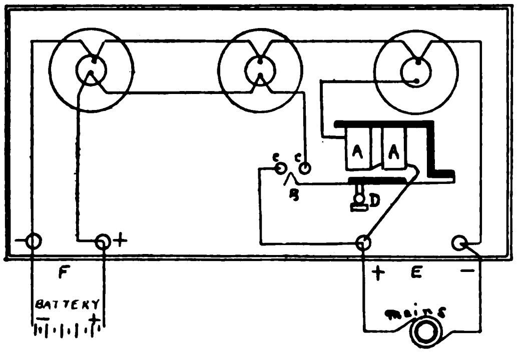
It is expected that 1924 will prove the most momentous and beneficial year for British trade since the war. In addition to the great exhibition at Wembley, the British Industries Fair at the White City is already assured of such support from overseas buyers as will probably establish a record.

Naturally the great mass of exhibitors at the Fair are manufacturers who have exhibited for years past, but space can usually be found for new firms by extending the area of the Fair, provided that applications are received in good time. Such applications should be made to the Secretary, British Industries Fair, 35, Old Queen Street, Westminster, S.W.1, from whom full information as to the most suitable way of organising contemplated exhibition displays can also be obtained.

AN ACCUMULATOR CHARGING CUT-OUT.

The following article and illustration are reproduced from a recent issue of our esteemed contemporary, the *Kinematograph Weekly*. The contributor's name appears at the end of the article, and the footnote comment is by Mr. Colin N. Bennett, the technical editor of that paper and well known as the author of that excellent text-book, "A Guide to Kinematography."*

"As town supply here is A.C., and several torch and other small accumulators constantly require charging, and generator runs only average two hours, some method of automatically connecting, and disconnecting, from mains was necessary. About an hour's work, an old electric bell, three batten holders, and a board, and the following device was evolved: One batten holder was placed in series with the magnet coils *AA* across the mains. Hammer was cut off and an inverted V contact piece fitted. Two contact pillars *CC* arranged, and two batten holders wired in parallel. Right-hand terminals connected to mains *E*. Batteries connected to terminals *F*. Carbon lamps placed in batten holders. On machine exciting, coils *AA* are energised, drawing up armature, forcing springy brass contact *B* between contact pillars *CC*, and completing charging circuit. Fall of armature can be adjusted by original contact screw and pillar to keep armature within field of coils. It was originally intended to add a series winding to coils, *i.e.*, taking charging current round a compound winding, but same works well without. If armature shows signs of sticking up, some thin stamp paper should be stuck on magnet tips. From T. Banfield, New Picture House, Malvern, Worcestershire."



(An idea combining considerable ingenuity with an equal simplicity. Anyone can make it up, though not everyone would have thought of the way to make it. This should be of much service wherever torch accumulators have to be charged from an intermittently running motor generator.—C. N. B.)

THE INSTITUTION DINNER.

At the annual dinner of the Institution of Electrical Engineers, which was held at the Hotel Cecil on Thursday, 21st inst., Dr. Russell presided over an attendance of about five hundred members and visitors, including such well-known men as Viscount Chelmsford (First Lord of the Admiralty), Sir Charles Sherrington (president, Royal Society), and a host of other notabilities whose names would be well known to the majority of our readers. The principal toast, viz., that of the Institution, was very ably proposed by Viscount Chelmsford, who opened his remarks with the pleasing news that Dr. Russell had that day been nominated for a fellowship of the Royal Society, and then went on to say that as First Lord of the Admiralty he had been there long enough to realise that the modern ship, and especially the modern warship, without electricity was almost inconceivable. Whatever activity there might be in the ship, electricity always came in. Wireless, for instance, in connection with naval operations, was of primary importance, of far greater importance than the aeroplane itself, because it depended upon the wireless whether the Fleet Commander was going to get the information he was expecting from his aircraft. Then, again, unless submarines had large secondary batteries, they would be useless. One of the most interesting things that had come his way during the last month at the Admiralty was to find that while there was a development of the potentialities of the submarines going on, there was, quite close, an anti-submarine department, and as submarines went ahead in one direction the anti-submarine department immediately proceeded to devise something by which the submarine could be countered, and they thus had that delicious game going on of one trying to get ahead of the other. It was through electricity that nearly all those things were devised. So far as the Navy was concerned they must be deeply indebted to electrical engineers, to whom they owed a great deal of their efficiency. On the other hand, the engineers must be indebted to the Navy, for it was through their increasing requirements and demands that engineers were provided, as a profession, with a stimulus for fresh invention and development.

The President, in responding, remarked that the activities of the Research Department of the Admiralty were reflected in the equipment of their latest vessels. They had proved that science was a weapon of greater potential value than weight of broadsides. Some of the activities of that department would prove of value to the mercantile marine; for instance, their radio acoustic method of locating the position of a ship at sea and communicating the result to the ship in a few minutes. This could be done in rough and foggy weather and in all seasons of the year. The method could doubtless be improved. He hoped that some of the younger radio engineers would turn their attention from devising new methods of receiving broadcasting to navigational problems which were in urgent need of solution. He felt that it was within their power to devise means by which a seaman in a cargo boat, or even a fishing smack, would be enabled to determine his position at sea quickly and easily. Radio had proved its value in navigation; let them develop it further to lessen the risks of those who went down to the sea in ships. (Cheers.) We were on the eve of many practical applications of radio broadcasting in the schools, and the time was rapidly approaching when our railways would be electrified. At the present time our railways were consuming unnecessarily some 6,000,000 tons of coal a year. The past year could be looked at with complacency by the supply industry. They had made steady progress. The price of electricity had been reduced and there had been an increase in the demand, and a consequent increase in the work of associated industries. They were looking forward with lively interest to the World Power Conference at the British Empire Exhibition, which would bring together engineers from every civilised country of the world, and it would work for a better understanding between nations. (Cheers.)

---

*Rentell, 11s. net, post free.

Mr. F. Gill (past president) proposed the toast of "Our Guests."

Sir William Clark (Comptroller of the Overseas Trade Department), who responded, declared that it was through British electrical engineers we maintained a high standard of quality which enabled us to keep our place in the markets of the world. (Hear, hear.)

Sir Ernest Rutherford (president of the British Association) and Colonel R. E. B. Crompton also replied to the toast.

Dr. S. Z. de Ferranti, who was awarded the Faraday medal for this year, returned thanks to the institution for the honour conferred upon him.

PROBLEMS IN TELEPHONY, SOLVED AND UNSOLVED.*

By PROFESSOR J. A. FLEMING, M.A., D.Sc., F.R.S.

(Continued from page 102.)

There are therefore three variables, viz., the plate current$i$, the plate voltage v_p, and the grig voltage v_g, to be considered. If we take these quantities to a certain scale to represent three rectangular co-ordinates of a point, their variation in the case of a *hard* or high-vacuum valve defines a certain surface called the *characteristic surface* of the thermionic valve (see Fig. 6), Sections of this surface give us the characteristic curves in two co-ordinates.†

On examining the characteristic surface it is seen that there is a certain region in which it is nearly flat or plane, and hence in this district the co-ordinates fulfil the condition for the equation to a plane, viz:—

$$i_p = av_g + bv_p \quad . \quad . \quad . \quad . \quad (26)$$

as first pointed out by M. Marius Latour, where a and b are certain parameters called the characteristic slopes.

If we take a section of the surface along any plane for which v_p or the anode potential is constant, we have a curve called the grid-plate current characteristic. The central part of this curve for a hard valve is very nearly a straight line, and the top and bottom parts of the curve where the line becomes parallel to the grid voltage axis are nearly parabolas (see Fig. 7). Within the limits of variation of grid voltage for which the characteristic remains nearly a straight line, any variation of this voltage results in an exactly similar mode of variation of the plate current, no matter how rapid the fluctuations of potential.

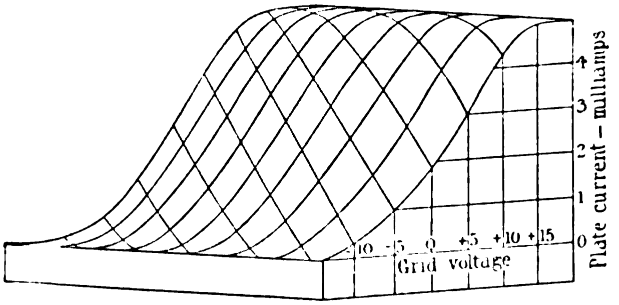


FIG. 6.—CHARACTERISTIC SURFACE OF THE HARD THERMIONIC R VALVE.

If we create the variation of grid voltage by variation in the terminal potential difference of a suitable transformer, the secondary terminals of which are connected to the grid and filament respectively, and if we connect the plate to the filament through the primary circuit of a transformer which includes also the high-voltage plate battery, then the variations of the potential difference of the secondary terminals of this last transformer will be an amplified copy of the variations of potential difference at the primary terminals of the grid transformer, provided these transformers are constructed in a suitable manner.

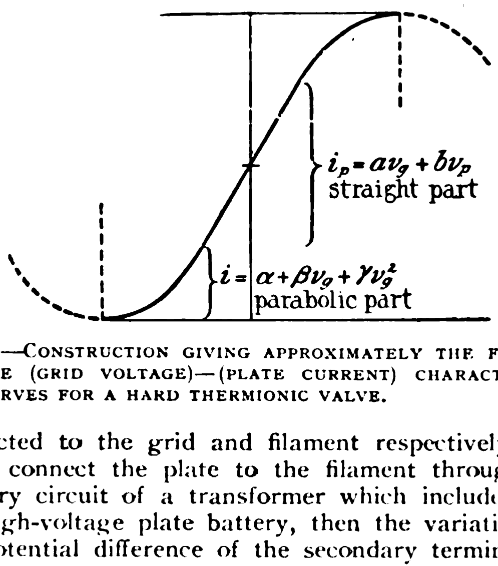


FIG. 7.—CONSTRUCTION GIVING APPROXIMATELY THE FORM OF THE (GRID VOLTAGE)—(PLATE CURRENT) CHARACTERISTIC CURVES FOR A HARD THERMIONIC VALVE.

(To be continued.)

Tenders Accepted.—The Southern Railway have accepted the tender of Siemens and English Electric Lamp Co. for the supply of incandescent electric lamps for the six months ending August 31, 1924.——The Siemens Lamp Co., Ltd., have been awarded the contract for the supply of a large quantity of Siemens gasfilled projector-type lamps for use at the British Empire Exhibition.

---

* Lecture delivered before the Institution of Electrical Engineers to whom we are indebted for the illustrations.

† The photograph from which Fig. 6 has been prepared was taken from a characteristic surface of the hard or high-vacuum valve commonly called an R valve, so much used in wireless telephony. This surface was modelled in plaster of Paris by Messrs. W. F. Marriage and H. A. Howse from careful electrical measurements made by them in the Electrical Engineering Laboratory of University College, London.

BIRMINGHAM AND DISTRICT ELECTRIC CLUB.

A meeting of the Birmingham and District Electric Club was held at the Grand Hotel, Colmore Row, Birmingham, on Friday, February 22, when a lecture was given on Automatic Telephony by Mr. H. E. Humphries, of Siemens Brothers and Co., Ltd., Woolwich.

The lecture was illustrated by lantern slides and explained by means of a working model automatic telephone equipment, by which a demonstration was given of the electrical and mechanical operations involved for the selection of any one line in 10,000 telephone lines.

At the close of the lecture there was a very full discussion, and some interesting particulars were given by Mr. T. Plummer, Superintending Engineer, G.P.O., Shrewsbury, who stated that plans were now in hand to install a complete automatic telephone system for the City of Birmingham, and it was expected the first exchanges for Central and Midland would be working in three years' time, and it was estimated that shortly afterwards there would be 42,000 automatic telephones in Birmingham and 75,000 stations by the year 1930. There are now about 1 per cent. of lines to population in Birmingham, whereas the average for the United States of America is 10 per cent. of lines to population.

Questions and Answers by Practical Men.

RULES.

QUESTIONS : *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS : *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

Commencing with Question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 177.

I am in charge of a large D.C. motor plant, and I wish to design a starter that will start, in case of emergency, any motor from 5 h.p. to 75 h.p. Can any reader give me some helpful suggestions which can be embodied in the design?—"TESTER."

QUESTION NO. 178.

When working a cinema projector on 200 volts 50 cycles, with a three-bladed shutter, an intermittent light was produced on the screen. By using a single-bladed shutter this was eliminated. Can any reader explain this to me?—"OPERATOR."

(Replies to Questions Nos. 177 and 178 must be received not later than March 29, 1924.)

Leaflets describing the M.K. Double-Pole Switch Plug and the M.K. Safety Plug have just been issued by the **M.K. Electric Co., Ltd.**, of Wakefield Street, Edmonton, N.18. They describe accessories which are certain to be of direct interest to all electrical installation contractors, and as such the lists are worth writing for.

Various Items.

E.D.A. Announcements.—The annual general meeting will be held at the Hotel Cecil, London, on Friday, March 21, 1924, at 12 noon, to be followed by the annual luncheon at 12.45 for 1 p.m.

Obituary.—We regret to announce the death, following an operation, on the 24th inst., of Mr. W. J. Kempton, for many years manager of the glass works of the Edison Swan Co. at Ponders End.

Removal.—The address of the Cardiff office of the Consolidated Pneumatic Tool Co., Ltd., is now No. 18, Bank Buildings, 98, St. Mary Street, Cardiff. Telephone, Cardiff 256; telegraphic address, "Caulking, Cardiff."

Additional I.E.E. Informal Meeting.—A discussion on the work of the International Conference on E.H.T. Lines, held in Paris in November, 1923, will be opened by Monsieur J. Tribot Laspière at 7 p.m on Monday, March 10, 1924.

I.E.E. Western Centre.—The next meeting of this centre will be held at the Chamber of Commerce, Cambrian Place, Swansea, at 6 p.m: on Monday next, March 3, when a discussion on "Electricity Supply Costs" will be opened by Mr. J. W. Burr, Vice-Chairman.

Reduction of Rates.—The directors of the Charing Cross E.S. Co. have decided that the rates for current in their West End districts shall, from the beginning of the year, be:—For lighting, 7d. per unit for the first 16 units per 30 watts installed per annum (instead of 20 as hitherto), and all units in excess at 3d. instead of 4d.; for power, 1¾d. per unit instead of 2¼d.

Annual Dinner.—The annual dinner of the Inst. of Engineering Inspection will be held on Wednesday, March 5, at the Hotel Cecil. The Right Hon. J. H. Thomas, M.P., H.M. Secretary of State for the Colonies, and other notable guests have kindly consented to be present. Tickets, 12s. 6d. each (excluding wine), may be obtained from the Secretary of the Inst. at Palace Chambers, Westminster, London, S.W.1.

Quotations Wanted.—The P.M.G.'s Dept. at Sydney invite tenders for protectors, terminals and jumper wire.——The N.S.W. Govt. Rys. at Sydney invite tenders for electric railway car equipments.——The Egyptian Ministry of the Interior at Cairo invite tenders for the following pumping plant:—Electric motors; transformers, switchboards, cables and lines.——The Egyptian Ministry of the Interior invite tenders for an electric power station and distributing system. Specifications, etc., of the D.O.T. (Room 52), 35, Old Queen Street, S.W.1.

Finance.—The directors of the Charing Cross E.S. Co., Ltd., recommend a final dividend on the ordinary shares of the West End undertakings of the company at the rate of 9s. 6d. per share, making, with the interim dividend already distributed, 14s. 6d per share for the year 1923. Also that the sum of £96,000, part of the general reserve (income) account of the West End undertakings, be capitalised and distributed among the holders of the ordinary shares in the form of one fully paid ordinary share in respect of every five such shares held on the 1st day of March, 1924.——The report of the Metropolitan E.S. Co., Ltd., for the year 1923 shows a net available profit of £240,649, and after the payment of debenture interest and making allowance for sinking fund, etc., together with £10,000 towards a staff pension fund, the directors recommend a further dividend of 14 per cent., making 10 per cent. per annum and leaving a balance of over £10,000 to be carried forward.——The report of the Electrical Distribution of Yorkshire, Ltd., for the year 1923 shows a total available profit of £22,774, and the directors recommend a dividend of 7 per cent. per annum on the ordinary shares, an addition to the reserve fund of £5,000, and to carry forward a balance of £7,274. Altogether a very satisfactory balance-sheet.

A useful catalogue, No. 402, of Sunco Wireless Receiving Sets and accessories has been issued by the **Sun Electrical Co., Ltd**, of Charing Cross Road, and will be sent to dealers and trade clients on proper application. It contains illustrations of a very large quantity of wireless apparatus of real merit which the company can recommend as likely to please private clients, and it is therefore well worth writing for by trade dealers. List No. 401 is a leaflet dealing with the electric lamp locks which comply with the Home Office regulations and for which there is an ever growing market in this country. Also it illustrates Sunco small power motors from 1/50 h.p. upwards, for both continuous and alternating currents.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
A PRACTICAL TRADE JOURNAL

MARCH 7, 1924.

CONTENTS.

PAGE
The C.T.S. Competition .. 121
Armature Reaction and Commutation .. 122
Lighting a Florist's Window .. 123
Correspondence .. 124
A Correction .. 124
New Digs for Higgs .. 124
Current Topics .. 127
Automatic Telephony .. 129
Problems in Telephony, Solved and Unsolved .. 130
Questions and Answers by Practical Men .. 131
Various Items .. 132
Trade Notes .. 132

THE C.T.S. COMPETITION.

Mr. S. J. Berryman was the winner of the second prize, and of his paper Mr. W. E. Highfield says:—

"This paper is well put together. There is little redundant matter and the subject is treated in sequence and the points are well illustrated. Finally, the subject is summarised at the conclusion in a table of 'advantages.' The paper merits the expression 'Good' and is given 70 per cent."

C.T.S. CABLES.

No doubt the majority of people who are connected with the supply of electricity are aware of the construction of C.T.S. (Cab Tyre Sheathed) cables; but for those who have their doubts, perhaps a little explanation would not be out of place. Each conductor consists of H.C. tinned copper wires, fully insulated with pure and vulcanised insulating rubber (as per standard of C.M.A.), then the insulated cores are twisted together and the whole covered with a layer of Patent Cab Tyre Sheathing, the interstices between the cores being filled with Cab Tyre Compound, making the whole cable solid and compact.

When we take into consideration the careless way cables are sometimes handled by unskilled and even skilled labour, sometimes resulting in kinks and broken insulation, especially with large-size V.I.R. cables, the construction of C.T.S. will be appreciated and speaks for itself, as these are two of the many things it will *not* do, let it be single, multicore or flexible.

When putting in an electrical installation of any kind the chief point of the engineer is efficiency, or should be. But the engineer must not always be blamed for using cheap and inferior cables. I am afraid a lot of people look at first cost as the most important item, but I think it is one of the biggest mistakes anyone can make. Upkeep should be their watchword. My motto is: "A good thing pays for itself in the long run."

It came to my lot about three years ago to put an installation "for light and power in a chemical laboratory." After all my arguments with regards to chemical action on ordinary conduit, it was decided to install same because of first cost.

RESULTS.

To-day the conduits are in such a state that shortly this laboratory will need to be rewired. I fail to see where the economy comes in. Should my services again be required I shall once more point out the advantages of C.T.S. and St. Helens Patent Junction Boxes, which I am satisfied would eliminate any further trouble.

The advantage of C.T.S. does not finish with chemicals, but will give equal service in salt works, dye works, bleach works, baths and laundries, stables, refrigerating plants, trailing cables on jetties, and in mines, generating stations (especially in battery rooms), street lighting, with special reference to seaport towns, or even under sea water if necessary, railways, trams, private-house wiring, portables of any and every description; in fact, anywhere and anyhow it is required to transmit electrical energy.

For the wiring of motors in "engineering" works, if desired, the cables may be laid under a cement floor, by this means dispensing with conduits or insulators. If a cable with an extra core is used for this purpose, the extra conductor may be used for earthing purposes.

To those who have the handling of electric lighting and starting sets on motors cars, C.T.S. is a boon.

When you consider the rough mechanical usage to which a cable is subject for this class of work, the danger of spilt acid, the heat which radiates from the engine, and very often the abrasion of the cable due to vibration, which puts it in contact with the mechanical parts, its possibility of being covered with oil, grease, petrol, dirt and water from washing the car, I fail to see what other cable is more adaptable, taking these things into consideration, than C.T.S. Joints can easily be made at any point to take leads to switch-board, battery, etc., these being covered by a suitable cement makes them perfectly watertight.

For private-house wiring it provides a first-class installation as no conduits or casing are required, and can be run along picture-rails or similar woodwork, standard fittings being used. One great advantage of using C.T.S. on A.C. circuits is no power is wasted in magnetising or eddy currents, as is the case when separate conduits are used for lead and return currents; also no bonding or earth connections are required. Another welcome feature is that it can be painted to match the colours of the room.

When a private-house installation is completed the insulation test has to be made, which sometimes proves to be low if V.I.R. or taped and braided wires are used. this being caused by the wireman leaving tape and braiding together as loose ends when connecting switches, etc. This allows a certain amount of current to leak at the ends of the wires, and has to be corrected before connection is made to the source of supply. This, of course, means extra expense, and could not occur if C.T.S. was used.

In my own experience I have come across cases during alterations where V.I.R. cables have been used, the insulation has been so saturated with damp and the conductors so covered with corrosive matter, that it would be impractical to use them again; yet when put in the situation was understood to be dry.

Another case comes to my mind of a private house wired with V.I.R. cables in capping and casing. At one of the switches the damp so penetrated the wood casing that the insulation was eaten clean away, leaving the conductors absolutely bare, with the result that it was only a matter of luck that a serious fire was adverted, the woodwork being scorched.

The tools required to install C.T.S. are hammer, screwdriver, pliers, screws and Rawlplugs, which shows it may be called the "No trouble and no mess system."

I do not know of any situation where C.T.S. could not be used with advantage.

I think the merits of C.T.S. may be summed up as follows:—

(1) Waterproof.
(2) Electrolysis-proof.
(3) Shock-proof.
(4) Resist corrosion.
(5) Unkinkable.
(6) Imperishable.
(7) Stands. heat.
(8) Stands hard wear.
(9) Perfectly safe in plaster.
(10) Very flexible.
(11) No special fittings, only in corrosive situations.
(12) Last, but not least, cheaply installed.

S. J. BERRYMAN.

Gustavus Road,
Camborne, Cornwall.

ARMATURE REACTION AND COMMUTATION.

BY G. WINDRED.

In the following article an attempt will be made to give a comprehensive description of the primary concepts of modern practice in respect of the commutation of D.C. generators.

There are several contributing factors to be taken into account when experimenting or calculating upon this interesting and important problem, but an effort will be made to exclude all unnecessary or irrelevant mathematics.

FUNDAMENTAL CONCEPTS.

In any dynamo armature, when running, we experience the phenomenon of armature reaction. The effect is produced by the action of the small fluxes set up in the armature conductors carrying current, and the result is a cross-magnetising, demagnetising and distortion of the field flux.

This will be seen from the diagram Fig. 1, in which the flux produced by the armature is indicated by the dotted lines encircling the conductors.

Since the main flux flows from left to right in the diagram, it is obvious that the reacting flux opposes the main field at *A* and *C*, and assists it at *B* and *D*, thereby producing a displacement of the field flux in the direction of rotation.

The cross-magnetising flux, due to the portions of the armature winding *A B* and *C D* lying immediately beneath the poles, acts at right angles to the main flux in the direction indicated by the dotted arrows.

Since the field is distorted, however, the actual position of these lines will be no longer parallel to *M N*, but will now be parallel to *X Y*, where α represents the angular displacement of the main flux; from which it is obvious that the neutral magnetic axis now lies along *X Y*, instead of *M N*, as previously. The brushes of the machine must, therefore, be moved through the angle α in order that the coil in the armature undergoing commutation may be short-circuited in a field of zero strength so that no spark-producing E.M.F. is induced.

A graphical representation of the foregoing in a 2-pole machine is given in Fig. 2. In this case the resultant flux is denoted by ϕ_r and its components, the main and armature flux by ϕ_f and ϕ_x respectively.

It is obvious that ϕ_x must vary directly with the current in the armature and, therefore, with the external load on the machine. The distance *M Y*, therefore, which is the length of the arc subtending the angle α at the centre, also varies with variations in armature load current; and in order to obtain sparkless commutation the angular displacement of the brushes must be altered to coincide with variations of load in the external circuit.

If double the angular displacement be represented by β we have

$$\text{Sin}\ (\beta/2) = \phi_x/\phi_f$$

This will be obvious from Fig. 3, in which the direction of ϕ_x is *B A*, while *B C* is the direction of the main flux ϕ_f.

The angle *A B D* is a right-angle, since the brush axis is at right-angles to the resultant flux ϕ_r and the reacting flux acts along *A B*. With the brushes in this, the ideal, position, maximum efficiency is ob-

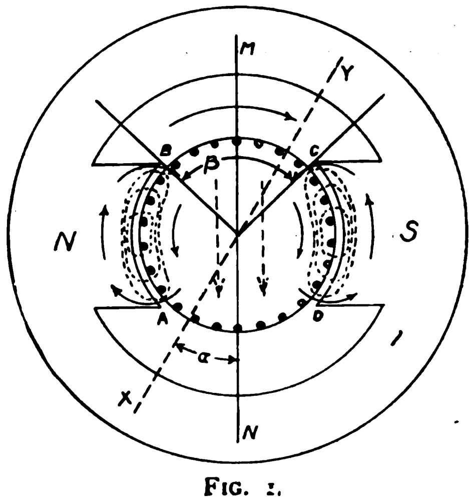


FIG. 1.

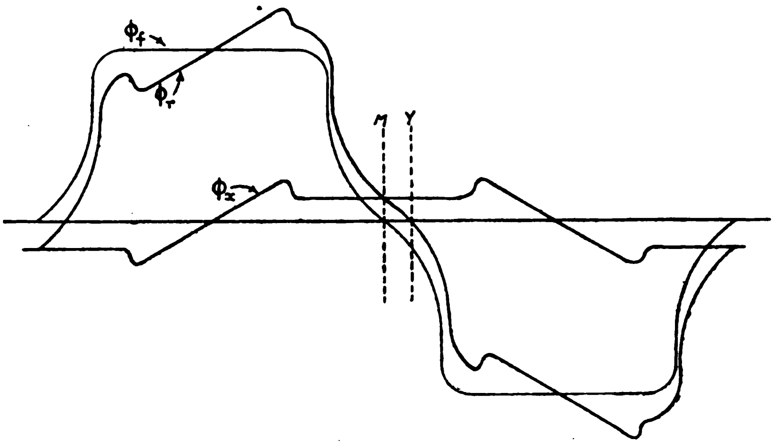


FIG. 2.

tained, since the machine produces the highest terminal voltage for a given load current.

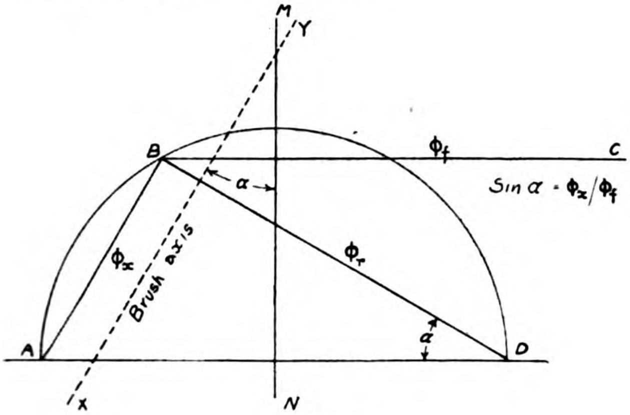


FIG. 3.

FURTHER CONSIDERATIONS.

If the brushes are advanced under the pole-tips and $\beta = 2\alpha$ as before, we may look upon the armature winding as consisting of two parts, the first of which lies within the angle β and the second within the remaining $180° - \beta$. It is obvious that the portion of the winding included in β lies in the neutral zone between the poles, whereas the second portion lies immediately below the poles.

The windings in the neutral zone are responsible for the demagnetising flux previously referred to. If the back ampere-turns producing this flux be denoted by X_b and there are 2_p parallel paths through the armature, we have

$$X_b = (I_a/2_p)\ (Z\beta/360),$$

which is applicable to either lap or wave windings, since the number of conductors included in β is $Z\beta/360$ where Z is the total number of conductors in series, and the current in each conductor is $I_a/2_p$ where I_a is the total armature currents.

The conductors in the remaining $180° - \beta$ produce a cross-magnetising flux at right-angles to the main flux, the ampere-turns producing which are given by

$$X_c = (I_a/2_p)\ (Z\beta/2).$$

If the average flux density in the air-gap is denoted by B_g, and B_c represents the cross-magnetising flux density, we know that

$$B_g = (0.4\,\pi\,X_g)/2l_g$$
$$B_c = (0.4\,\pi\,X_c)/2l_g$$

the reluctance of the iron being neglected, and l_g being the length of the air-gap in cm.

Since the flux-density under the commutating tips of the poles must obviously be equal to

$$B_g - B_c$$

the flux-density of the commutating field is given by

$$B = [(X_g - X_c)/(2l_g)]\ 0.4\,\pi.$$

With these conditions it is obvious that X_c may rise to a value which would render sparkless commutation impossible. To prevent this, commutating poles are introduced. These are also called interpoles, and were originally introduced by Menges in order to neutralise the effect of X_c on the commutation of machines. These interpoles serve a dual purpose, since they produce a flux proportional to the armature current which flows through them in series, which is used to oppose the flux of cross-magnetisation, and also to induce an E.M.F. in the opposite direction to that flowing in the short-circuited armature coil undergoing commutation. It is, therefore, obvious that by suitably designing the commutating poles, the output of the machine is limited solely by the heat developed in the armature at high loads.

(To be continued.)

LIGHTING A FLORIST'S WINDOW.

From time to time, electrical contractors who specialise in scientific illumination receive inquiries for lighting schemes for types of buildings they have not met with previously. There are very few shops devoted entirely to the sale of flowers, and, though the lighting of a florist's window does not usually present any new problem, a few particulars given below of the lighting of such a shop window may be of particular interest, and the illustration reproduced shows the very excellent effect which can be obtained when correct window illumination is applied.

The windows in question are those of Mr. E. Goodyear, the well-known court florists, of 16, Royal Arcade, Old Bond Street. When a new scheme of window lighting was decided upon experiments were made, and it was finally resolved to use 100-watts Osram gasfilled lamps, equipped with Gecoray mirrored glass reflectors, arranged in one row at the front of the window ceiling.

So far the installation is quite a standard one, and calls for no special comment; but from the constructional point of view there were several serious difficulties to be overcome.

In the first place, the ceiling of the window was of mirror glass, which provided no fixing for the reflector. The ceiling had, therefore, to be specially battened, and the reflectors themselves were semi-flush sunk in special casing. A specially designed Pelmet was supplied to hide the reflectors, and, as will be seen from the photograph, the lights are entirely hidden from the street, neither is any light from the windows projected on to the pavement.

In all 18 Gecoray mirror glass reflectors, each equipped with one 100-watt Osram gasfilled lamp, are employed. In addition, two G.E.C. "Baby" spot lights are installed, and after a certain hour each evening the main reflectors are switched off, and the two spot lights are left burning to illuminate the centre piece of the display.

The contract for the installation was entrusted to the Electric Power Installation Company, of Station Approach, Church End, Finchley, who are to be congratulated upon a very workmanlike installation. The illustration shows the very striking effect of the lighting by night, and proves very conclusively that the appearance of a shop window, and therefore its publicity value, is very greatly increased when a proper system of illumination is installed.

Correspondence.

DANGER OF ERECTING AERIALS NEAR OVERHEAD ELECTRIC LIGHT WIRES.

To the Editor of Electricity.

Sir,—We have had so much trouble with aerials falling on our lines that, on application to the Cardiff Station of the British Broadcasting Company, warning was broadcast by them on January 1 to people erecting aerials, mentioning an instance that we had where persons erecting an aerial over a 400-volt lighting overhead circuit allowed the aerial to drop on the power line. Fortunately, the safety device in the local sub-station operated to make the line dead, otherwise the erectors would have received a severe shock.

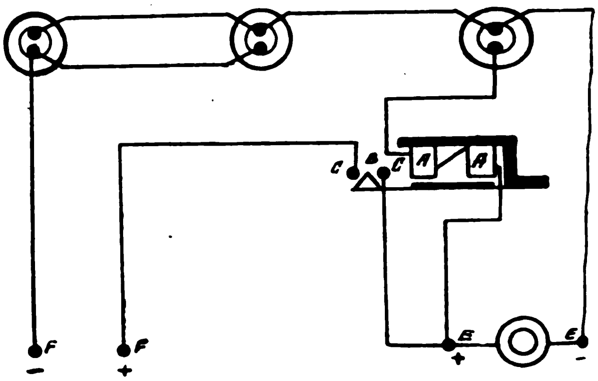
In addition to this, great inconvenience was caused to many of the consumers through supply being cut off until the cause of the trouble was found and removed. Of course, the above warning only affected those who had already erected their aerials, so, in order to warn others who proposed to erect aerials, we have had the attached notice fixed to lighting poles in all our districts.

Yours faithfully,
C. T. Allan, Assistant Manager,
South Wales Electrical Power Distribution Co.
Royal Chambers, Queen Street,
Cardiff, February 28, 1924.

[This matter should receive the most careful attention of all wireless enthusiasts. It is also referred to in "Current Topics," but owing to pressure on space we could not reproduce the actual notice.—*Ed.*, Electricity.]

A CORRECTION.

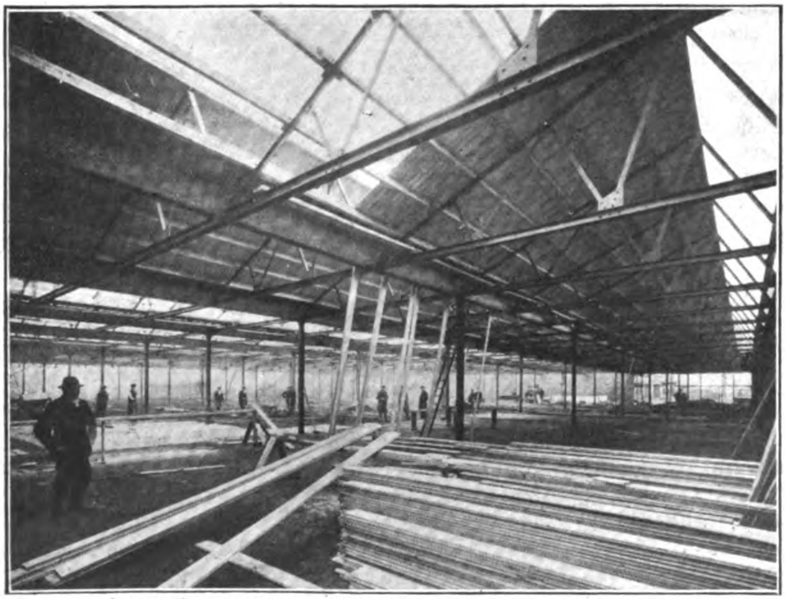
In our issue of February 29 an accumulator charging cut-out was described. The description was illustrated by a circuit diagram which, we regret to say, was



drawn incorrectly. We have pleasure in herewith correcting the error, and publish a correctly drawn diagram of the charging circuits referred to in the article.—Editor, Electricity.

NEW DIGS FOR HIGGS.

Some time ago we had the pleasure of informing our readers that Messrs. Higgs Brothers, the well-known motor makers of Sand Pits, Birmingham, were building new works at Witton in order to cope with the steady increase in the demand for their machines. The annexed illustration shows the new works in course of construction, and will give some idea of their importance. The building is constructed with the express purpose of manufacturing motors up to a weight of one ton. The roof and flooring are of the best possible construction. The building is approximately square, with one permanent wall only, so that extensions can take place on three sides. It is north lighted, and there are no outbuildings. When completed and in full swing we hope to visit these new works and to give our readers further interesting particulars. Likewise a few new Higlets.



New Works for Messrs. Higgs Brothers.

Don't worry! THERE IS A BENJAMIN REFLECTOR for EVERY CLASS of LIGHTING INSTALLATION.

Advert. of the Benjamin Electric Ltd., Brantwood Works, Tariff Road, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and Abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Tuesday morning, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

Broadcasting Rule of Thumb.

Perhaps the most astonishing thing about broadcasting is the universal "hit-and-miss" principle applied in practice to this very scientific hobby. The literature of wireless telephony simply bristles with technical terms, circuits, and practical gadgets of all kinds, but one never comes across any quantitative data relating to reception and reproduction of the broadcasted speech and music. Quantitative analysis would appear to be absolutely unknown to the wireless enthusiast. Whilst it is a fact that there are several factors associated with broadcasting which are inconstant, uncontrollable, and immeasurable, it is nevertheless possible to control and measure several of the principal electrical characteristics, and it is highly probable that closer attention to this possibility by amateurs and listeners would materially assist the progress of the science and bring about earlier improvements.

It is the exception rather than the rule to find even such simple instruments as a voltmeter and a milammeter associated with any receiving set; yet these elementary instruments would enable the user to accumulate some invaluable data in connection with observed results under varying atmospheric and other conditions. With a suitable voltmeter it is possible to adjust, very precisely, the exact filament voltage which bests suits the particular set, and very simple change-over facilities would enable this adjustment to be made individually for each valve, H.F., detector, and L.F. respectively. Similar remarks apply to the H.T. current flowing whilst the several valves are active. A series of measurements of the values of these currents in milliamperes would enable the listener to reproduce the results obtained on the most favourable occasion as determined by his present rough-and-ready method of trial and error tuning.

The measurement of capacity and inductance are not so readily carried out by the amateur unless he possesses the necessary apparatus and experience of laboratory methods. By ignoring these factors, or taking them for granted, however, he misses quite an important characteristic of his set, and it is very doubtful whether any but the more reputable and larger manufacturers, possessing the necessary workshop facilities, could truthfully guarantee the capacity and impedance values of the fixed and variable condensers, tuning coils, vario-couplers, and other components they so glibly advertise as "three O's three," "two O's one," etc. It would be extremely interesting to carry out a series of laboratory measurements of some of the leading makes of wireless condensers to see how near their values really are to the figures marked upon them.

The factors which determine the capacity of a condenser are the areas of its facing electrodes and the thickness and character of the insulating medium, whether it be a layer of air, mica or paraffined paper. It is probable that most makers are content with calculating the size of plate and insulator to give a certain theoretical capacity, and, for the most, to trust to luck. Seeing that an infinitesimal variation in the thickness of the separating medium, such as may arise from uneven clamping pressure, will give rise to a considerable error in the ultimate capacity as compared with the calculated value, it is odds against the marking on the mass production article being within a considerable percentage of the true capacity.

Similar remarks apply to the conventional type of variable condenser, in which a constant and accurately gauged air-gap plays an important part. I have examined so-called variable condensers which could not, in the nature of things, be expected to register the same capacity with the same setting of the movable vanes twice running. Again, there is that imperfectly understood quality, impedance, as applied to tuners, variometers, etc. Here, again, the amateur as well as the less-experienced makers, are prone to speak in terms of so many turns of wire of such-and-such a gauge, wound on a cardboard or other insulating tube of more or less indefinite dimensions, and in nine cases out of ten without the remotest idea of the resultant value of the impedance offered by the finished article.

So long as he has knobs to twist and a receiver capable of emitting corresponding sounds, the average listener remains perfectly satisfied, and in the circumstances it is remarkable that such wonderful results have been achieved by amateurs. It is for that very reason that one is led to the conclusion that a little more attention devoted to the quantitative side of the subject would probably bring about still greater advances in our knowledge and practical application of this fascinating science. Thus it is highly probable that a carefully compiled analysis of all the measurable factors incidental to such freak receptions as the picking up of American stations on single-valve sets would supplied to hide the reflectors, and, as will be seen from the photograph, the lights are entirely hidden from the street, neither is any light from the windows projected on to the pavement.

In all 18 Gecoray mirror glass reflectors, each equipped with one 100-watt Osram gasfilled lamp, are employed. In addition, two G.E.C. "Baby" spot lights are installed, and after a certain hour each evening the main reflectors are switched off, and the two spot lights are left burning to illuminate the centre piece of the display.

The contract for the installation was entrusted to the Electric Power Installation Company, of Station Approach, Church End, Finchley, who are to be congratulated upon a very workmanlike installation. The illustration shows the very striking effect of the lighting by night, and proves very conclusively that the appearance of a shop window, and therefore its publicity value, is very greatly increased when a proper system of illumination is installed.

Correspondence.

DANGER OF ERECTING AERIALS NEAR OVERHEAD ELECTRIC LIGHT WIRES.

To the Editor of Electricity.

Sir,—We have had so much trouble with aerials falling on our lines that, on application to the Cardiff Station of the British Broadcasting Company, warning was broadcast by them on January 1 to people erecting aerials, mentioning an instance that we had where persons erecting an aerial over a 400-volt lighting overhead circuit allowed the aerial to drop on the power line. Fortunately, the safety device in the local sub-station operated to make the line dead, otherwise the erectors would have received a severe shock.

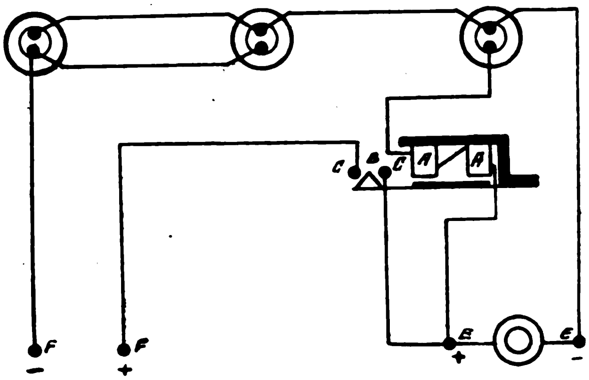
In addition to this, great inconvenience was caused to many of the consumers through supply being cut off until the cause of the trouble was found and removed. Of course, the above warning only affected those who had already erected their aerials, so, in order to warn others who proposed to erect aerials, we have had the attached notice fixed to lighting poles in all our districts.

Yours faithfully,
C. T. Allan, Assistant Manager,
South Wales Electrical Power Distribution Co.
Royal Chambers, Queen Street,
Cardiff, February 28, 1924.

[This matter should receive the most careful attention of all wireless enthusiasts. It is also referred to in "Current Topics," but owing to pressure on space we could not reproduce the actual notice.—Ed., Electricity.]

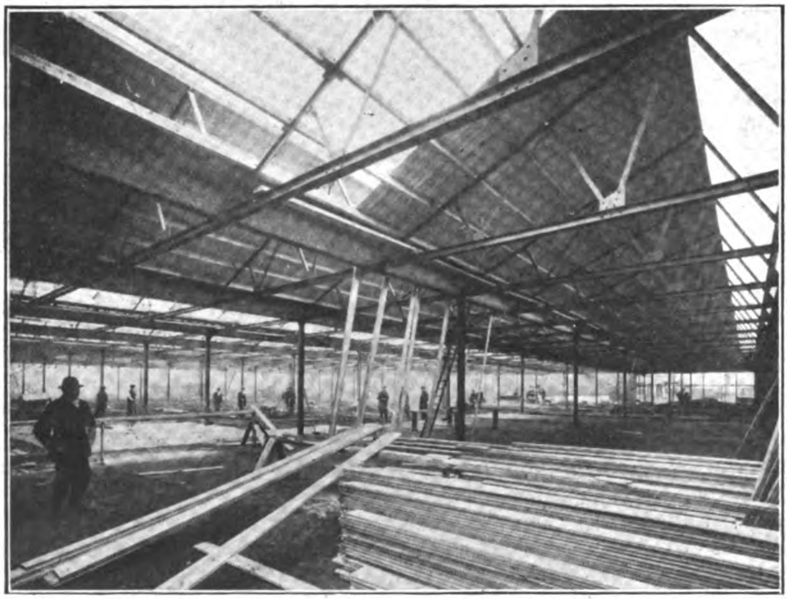
A CORRECTION.

In our issue of February 29 an accumulator charging cut-out was described. The description was illustrated by a circuit diagram which, we regret to say, was drawn incorrectly. We have pleasure in herewith correcting the error, and publish a correctly drawn diagram of the charging circuits referred to in the article.—Editor, Electricity.

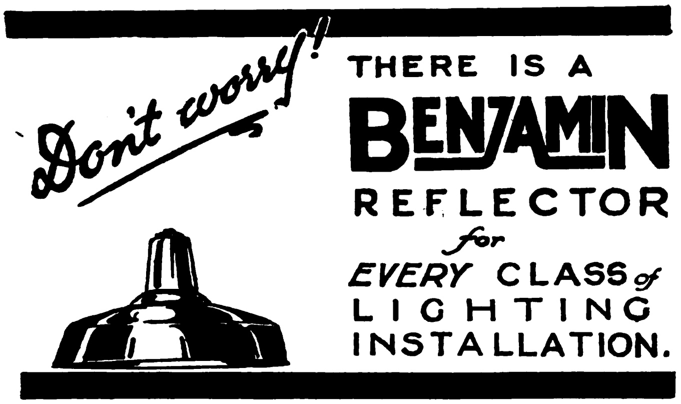


NEW DIGS FOR HIGGS.

Some time ago we had the pleasure of informing our readers that Messrs. Higgs Brothers, the well-known motor makers of Sand Pits, Birmingham, were building new works at Witton in order to cope with the steady increase in the demand for their machines. The annexed illustration shows the new works in course of construction, and will give some idea of their importance. The building is constructed with the express purpose of manufacturing motors up to a weight of one ton. The roof and flooring are of the best possible construction. The building is approximately square, with one permanent wall only, so that extensions can take place on three sides. It is north lighted, and there are no outbuildings. When completed and in full swing we hope to visit these new works and to give our readers further interesting particulars. Likewise a few new Higlets.



New Works for Messrs. Higgs Brothers.



Advert. of the Benjamin Electric Ltd., Brantwood Works, Tariff Road, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and Abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Tuesday morning, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

Broadcasting Rule of Thumb.

Perhaps the most astonishing thing about broadcasting is the universal "hit-and-miss" principle applied in practice to this very scientific hobby. The literature of wireless telephony simply bristles with technical terms, circuits, and practical gadgets of all kinds, but one never comes across any quantitative data relating to reception and reproduction of the broadcasted speech and music. Quantitative analysis would appear to be absolutely unknown to the wireless enthusiast. Whilst it is a fact that there are several factors associated with broadcasting which are inconstant, uncontrollable, and immeasurable, it is nevertheless possible to control and measure several of the principal electrical characteristics, and it is highly probable that closer attention to this possibility by amateurs and listeners would materially assist the progress of the science and bring about earlier improvements.

It is the exception rather than the rule to find even such simple instruments as a voltmeter and a milammeter associated with any receiving set; yet these elementary instruments would enable the user to accumulate some invaluable data in connection with observed results under varying atmospheric and other conditions. With a suitable voltmeter it is possible to adjust, very precisely, the exact filament voltage which bests suits the particular set, and very simple change-over facilities would enable this adjustment to be made individually for each valve, H.F., detector, and L.F. respectively. Similar remarks apply to the H.T. current flowing whilst the several valves are active. A series of measurements of the values of these currents in milliamperes would enable the listener to reproduce the results obtained on the most favourable occasion as determined by his present rough-and-ready method of trial and error tuning.

The measurement of capacity and inductance are not so readily carried out by the amateur unless he possesses the necessary apparatus and experience of laboratory methods. By ignoring these factors, or taking them for granted, however, he misses quite an important characteristic of his set, and it is very doubtful whether any but the more reputable and larger manufacturers, possessing the necessary workshop facilities, could truthfully guarantee the capacity and impedance values of the fixed and variable condensers, tuning coils, vario-couplers, and other components they so glibly advertise as "three O's three," "two O's one," etc. It would be extremely interesting to carry out a series of laboratory measurements of some of the leading makes of wireless condensers to see how near their values really are to the figures marked upon them.

The factors which determine the capacity of a condenser are the areas of its facing electrodes and the thickness and character of the insulating medium, whether it be a layer of air, mica or paraffined paper. It is probable that most makers are content with calculating the size of plate and insulator to give a certain theoretical capacity, and, for the most, to trust to luck. Seeing that an infinitesimal variation in the thickness of the separating medium, such as may arise from uneven clamping pressure, will give rise to a considerable error in the ultimate capacity as compared with the calculated value, it is odds against the marking on the mass production article being within a considerable percentage of the true capacity.

Similar remarks apply to the conventional type of variable condenser, in which a constant and accurately gauged air-gap plays an important part. I have examined so-called variable condensers which could not, in the nature of things, be expected to register the same capacity with the same setting of the movable vanes twice running. Again, there is that imperfectly understood quality, impedance, as applied to tuners, variometers, etc. Here, again, the amateur as well as the less-experienced makers, are prone to speak in terms of so many turns of wire of such-and-such a gauge, wound on a cardboard or other insulating tube of more or less indefinite dimensions, and in nine cases out of ten without the remotest idea of the resultant value of the impedance offered by the finished article.

So long as he has knobs to twist and a receiver capable of emitting corresponding sounds, the average listener remains perfectly satisfied, and in the circumstances it is remarkable that such wonderful results have been achieved by amateurs. It is for that very reason that one is led to the conclusion that a little more attention devoted to the quantitative side of the subject would probably bring about still greater advances in our knowledge and practical application of this fascinating science. Thus it is highly probable that a carefully compiled analysis of all the measurable factors incidental to such freak receptions as the picking up of American stations on single-valve sets would enable such accomplishments to be repeated at will, given favourable atmospheric conditions, and without undue burning of the midnight oil in the process.

Wembley and Textbooks.

The magnificent display of applied electricity promised at the forthcoming British Empire Exhibition will undoubtedly surprise many of our readers not yet fully acquainted with all the manifold possibilities of electrical service. They will see at Wembley, among the hundreds of electrical accessories with which they are already familiar, many strange objects which have not yet come within their practical experience, and concerning which they will naturally be anxious to learn as much as possible, both by actual inspection of the articles as well as by reading and studying the available literature on the subject. It follows that now is the time to increase your electrical library and get your preliminary reading and study over whilst the cold days persist, so that, when you actually visit Wembley, you will be armed with a certain amount of preliminary lore on the subject, and be better able to understand and inquire into the intricacies of the plant and apparatus on view in the electrical section.

For the convenience of our readers, we always carry a large stock of the latest textbooks on all branches of electrical engineering and the applications of electricity. We have both practical and theoretical treatises on all these subjects, and at prices to suit all pockets, and shall be pleased to furnish full lists to any interested reader. It will also be of interest to our regular subscribers to learn that we shall be on the spot, in the Palace of Engineering, with a representative selection of electrical and other books, from which interested visitors can make their choice. We shall be happy to welcome any of our readers who care to pay us a visit during the run of the Exhibition.

Aerials and Transmission Lines.

A letter, which we reprint in another column, draws attention to a danger which has been experienced by the South Wales Electrical Power Co., in connection with the erection of wireless aerials in too close proximity to its overhead distributing mains. Apart from the danger of actual contact between an indifferently erected aerial or a sagging wire, with bare conductors charged to a potential of 400 volts, there is the obvious fact that no wireless receiving set connected to such an aerial can be expected to yield satisfactory results, due to the interference set up by the heavier power currents and the inductive and shielding effects of the distributing network. The conditions are analogous to those obtaining in the vicinity of overhead trolley wires on electric tramway routes, although in the latter case, due to the position of the conductors, it is impossible for listeners to erect their aerials in such a position as to risk actual contact. As a warning of the attendant risks, the South Wales Electrical Power Co. has drafted a very appropriate and humorous poster, which is now displayed on all poles carrying lighting wires in that district.

Electricity "on the Cheap."

But one consumer has solved his electric-light bill problem—or had, before his little scheme was discovered. After a deal of consideration, he decided that the best way to cut down his quarter's bill was not to economise in light at all—oh, no! —he *wanted* light. So, with a couple of needles stuck into the current leads of his meter and connected together, he persuaded the quite agreeable "juice" to give the meter the go-by. Result: Plenty of light (more than ever, the extravagant wretch!) and a surprising slump in the units. Indeed, the meter got very independent, and gave up asking for pennies. But the schemer found that, although he saved quite a lot of pennies, the magistrates who were told about it didn't like his method of thrift in the least, and to his great dismay required him to hand over £5—twelve hundred pennies, mind you! You know, I don't think his wife will miss any more needles from her work-basket.

And to-day, as ever was, up comes one of our inspectors and reports that So-and-so, whose meter was removed several days ago and the supply leads sealed off, was discovered last night with his house "a blaze of light." Seemingly our old consumer missed our past connections, or felt he must have light, even at any cost—so long as it was not to him. So he bared the cables and connected up again. He must have known something about wiring, don't you think? It looks suspicious to me. But perhaps he worked out that the house lighting was a valve set, and that you simply had to connect the two leads to the supply company's aerial and earth.

These jokers who like cheap current are always turning up. Once upon a time, and in these very columns, too, I mentioned some typical cases. There was the wily Chinaman who found that drilling a tiny hole in the meter-case and pushing through an invisible hair on to the disc brought down the units in a very satisfactory way to himself. I ought to have told of how someone found that with a pendulum type of meter you could tilt it up, stop the pendulum, and give the meter dial a long rest; and of how, the good news spreading, all similar meters in the neighbourhood had to be removed. And then there was the clever chap who kept his motor running all day and all night as well; but at night he reversed the meter pressure leads, and thus wiped out the consumption of the day. Why didn't the silly fellow, if he knew so much, leave the meter disconnected? Aha! If an inspector called in the daytime, there the meter was behaving itself. A puzzled inspector *did* call one day, but there came a time when the motor's untiring efforts drew him there at night—and he "saw daylight"!

A Gecophone Film.

One of the newest educational films now on the market is that produced recently by the General Electric Co., Ltd., in order to enlighten the public generally to the many advantages of a Gecophone wireless set as a means of rendering present-day home life more attractive to old and young alike, and incidentally showing the various stages of manufacture at the company's Coventry works. It was a most interesting film, and I can say quite frankly that, when I saw it last week, I was much impressed with its humour as well as with its practical value as an education in the growth of British industry as handled by a live firm. I trust that it will be made use of very largely in schools, colleges and public institutions generally, because, as a Gaumont production, the film technique is everything that can be desired, and from the members of the Government downwards we are all anxious to promote British industry to the utmost of our power.

I know that many of my readers are operators in picture palaces, and I hope, therefore, that they will do their best to bring the film to the notice of their management, as well as to the chiefs of any scientific institutions or schools where films are shown. Particulars can easily be obtained by writing to the publicity department of the General Electric Co., Ltd., at Magnet House, London, W.C.2. When you watch the hundreds of employees pouring out of the factory at dinner time it will give you a feeling of pleasure to think that you are helping to promote the welfare of a big British industrial enterprise. I know it does to me.

ELEKTRON.

AUTOMATIC TELEPHONY.*

Telephone intercommunication has undergone great improvement within the last few years, and to-day we see the automatic system being largely adopted by both public and private administrations in all parts of the world, not as an experiment, as has frequently been the case in the past, but as a sound business proposition.

Automatic telephony appeals mostly to the layman on account of its high standard of service; in comparison with the type of manual system as installed in this country, some of its advantages in this respect can briefly be summarised as follows:—

Connections are established more quickly, particularly in the case of calls routed viâ two or more exchanges.

Wrong number troubles are eliminated. Where the human element is introduced, as in manual practice, wrong numbers inevitably will occur, either due to pronunciation difficulties or due to inaccuracy on the part of the telephonist.

"Number cut off" troubles and those of double connections are eliminated. This is also due to the absence of the human element at the exchange.

The language difficulty as experienced in cosmopolitan cities is effectively overcome. The numerals which appear on the face of the calling dial are universally intelligible.

The automatic system permits calls to be made in rapid succession. The momentary depression of the switch hook for about a second causes a call to be released, and a second call can then immediately be put in progress.

As there are no telephonists to listen in, secrecy is ensured. To most private business men this is a facility which is largely appreciated.

The automatic system is ready to take a call at any hour of the day or night throughout the year. The advantages of a continuous and reliable service, especially throughout the night, are particularly apparent in contingencies such as medical and fire calls.

The first cost of an automatic exchange is more than that of an equivalent-sized manual exchange, but this does not infer, however, that, for the public service at least, the automatic system is not the best investment. On the contrary, the overall cost of an automatic system throughout its economic life is appreciably less than that of its manual equivalent. Still better is the investment when the improved service given by the automatic system is taken into consideration.

The large capital outlay of an automatic exchange causes slightly more annual depreciation and interest charges, but the operating costs of the manual system as represented in wages for telephonists, supervisors, staff on holidays, staff away sick, etc., bring the overall annual costs of the manual system far above those of the automatic.

In small private exchanges of, say, 50 lines capacity, it is not always possible to prove automatic working as a better investment than a manual exchange. One case of this is when a large proportion of calls are routed to the main public exchange, in which event, under the present Post Office arrangements, a manual operator would in any case have to be provided at the private exchange for handling such traffic. Despite such extreme cases, however, it is generally found that the automatic system is a sound investment; this, perhaps, is exemplified by the fact that most private automatic users are the manufacturing companies' best salesmen.

Another money-saving feature of the automatic system is that it permits appreciable line plant economy in large telephone networks. In an automatic network it is possible to erect a small sub-exchange in any locality where the telephone call density rises sufficiently to justify the provision of an exchange. In manual networks it would also become desirable under the same conditions to erect a small manual exchange, but such action is often rendered impracticable on account of the staffing and building expenses that would be incurred. In this latter case, therefore, all lines must still lead to the nearest large exchange, whereas in the automatic system the erection of an additional sub-exchange would permit an appreciable reduction in the length of each subscriber's line and only require a comparatively few junction lines between the main exchange and the sub-exchange. In localities where the telephone rental varies according to the length of line, this is a most important consideration from the subscriber's viewpoint.

Telephone traffic, of course, does not consist of only one particular and straightforward type of call. The types are many and varied and introduce corresponding variations in the procedure of establishing such calls. On this account the layman is apt to think it too much to give a subscriber the full control over his call. This is not so, however, as practice has shown that the average person is quite capable of handling an automatic telephone properly after a few minutes' instruction and practice. After an inspection of a large modern automatic exchange the average person might also express surprise that a call could find its way properly amongst the apparent maze of intricate apparatus and wiring. Automatic exchanges admittedly have an appearance of complexity and might look very uncanny to the uninitiated, but, like many other modern devices of similar characteristics, they work surely, efficiently and with comparatively little maintenance effort.

---

* Brief outline of a Lecture before the Birmingham and District Electric Club on February 22.

A characteristic of the automatic system is its flexibility: firstly, as regards the disposition of apparatus in the exchange; secondly, the ease in which it can be adapted to meet changes in traffic conditions; and thirdly, as regards the great variety of operations it can be made to perform. An example which is of more than usual interest and which appertains to the last of the foregoing features is the method of handling calls to private branch exchanges. The actual scheme employed varies slightly with the different manufacturers; a representative idea of modern practice, however, can be obtained from the following description of the Siemens method of P.B.X. working. For general call purposes only one number appears in the directory, such as "5934"; this holds good even for private branch exchanges having up to 30 or 40 lines leading to the main exchange. On dialling 5934, for example, connection to such line is established if it is free; if it is engaged and the next line, "5935," is free, connection to this second line is made. In this manner selection of the first free line in the group of lines is made. If all lines are engaged, the caller is given the busy tone.

Many private exchanges have a few extensions connected directly through to the main exchange during night hours. This feature enables a works manager, for instance, to get into direct communication with his garage. If the garage line is engaged the manager would not want his call to be directed to the boiler-house, an extension which might be connected to another of the exchange lines. To meet such cases, the "automatic selection of a free line" feature is prevented if an intermediate line such as "5935" is dialled. Thus, "night lines" can be connected to intermediate numbers of the group, and if such a line, on being called, is engaged, the caller is immediately given the busy signal.

PROBLEMS IN TELEPHONY, SOLVED AND UNSOLVED.*

By **PROFESSOR J. A. FLEMING**, M.A., D.Sc., F.R.S.

(*Continued from page 119.*)

Owing to the complete absence of inertia and the manner in which the plate current responds instantly to changes in grid potential, the combination of suitable transformers and thermionic valve or amplifier constitutes a relay or repeater applicable to telephony, and by means of which any variation of potential at one pair of terminals is repeated and amplified at the other pair, no matter how rapid or how complicated these changes of potential may be. The construction of a thermionic repeater which will operate without distortion of speech sounds is dependent upon careful proportioning of the valve structures and the transformers and upon the limitation of the range of the grid potential to the central portion of the characteristic curve, which must be very approximately a straight line over that range. Subject to these conditions any type of good hard thermionic three-electrode valve will serve as a telephone repeater.

The British Post Office employ a type of thermionic repeater not very different from the valve used so much in wireless reception. It comprises a drawn tungsten wire filament surrounded by a spiral wire grid, this again being embraced by a cylindrical anode. The connections from filament, grid and cylinder are brought down to a four-pin collar fitting into a socket in such fashion that it is impossible to make wrong connections in replacing a broken valve.

The Western Electric Company of America have developed a low-temperature thermionic repeater in which the hot filament consists of a narrow strip of platinum-iridium coated with a mixture of barium oxide and strontium oxide. When the strip is heated by a current to dull red heat the oxides give off a copious evolution of electrons, as first shown by Wehnelt. The process of treating consists in mixing the carbonates of the metals with resin or paraffin and painting this mixture on the strip in several coats. After each application the temperature of the strip is raised to 1,000 deg. F. to burn off the organic carrier. This forms a firmly adhering layer of oxide which emits electrons readily on heating to about 500 deg. F. or 600 deg. F. The life of the coated strip is claimed to be longer than that of the tungsten wire, which latter must be worked at a far higher temperature.

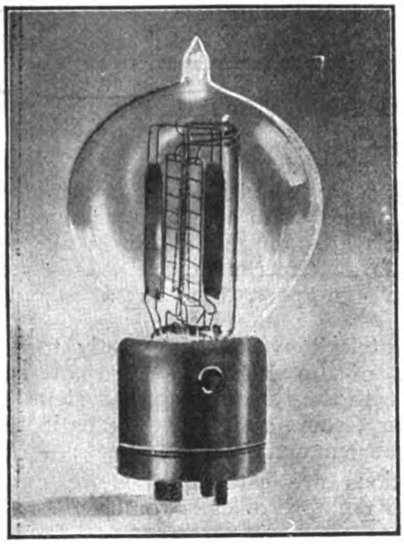


FIG. 8.—WESTERN ELECTRIC COMPANY'S THERMIONIC TELEPHONE REPEATER WITH OXIDE-COATED METALLIC FILAMENT.

The Western Electric Company fix this coated filament between two flat-plate anodes with very open mesh grids between (see Fig. 8). The combination of two transformers and a thermionic amplifier constitutes then a one-way telephone repeater in which the energy required for amplification of speech sound energy is drawn from the battery in the plate circuit (see Fig. 9).

If it were possible to employ independent telephone circuits for speech in each direction, and if only one repeater were necessary in the line, the above simple arrangement would meet the requirements. Telephone circuits have, however, to operate equally in both directions.

---

* Lecture delivered before the Institution of Electrical Engineers to whom we are indebted for the illustrations.

If the repeater could always be placed at the electrical centre of the line, then various modes of connection, in principle due to Edison, would enable telephone currents arriving from one direction to be retransmitted with augmented energy to the continuation of the line.

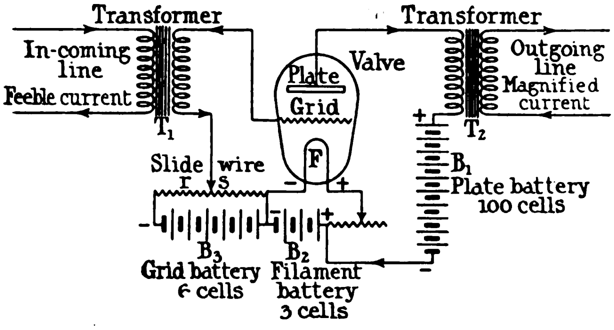


FIG. 9.—THERMIONIC THREE-ELECTRODE VALVE AND ASSOCIATED INPUT AND OUTPUT TRANSFORMERS EMPLOYED AS A TELEPHONE REPEATER.

One such mode of connection is shown in Fig. 10, taken from a paper by Sir William Noble on "The Long-Distance Telephone System of the United Kingdom."* It will be seen that the grid transformer of the repeater is connected across the line. The grid has therefore a fluctuating voltage put upon it, due to the speech currents. The plate current of the repeater passes through the primary of another induction coil and reacts on the line through a four-coil secondary circuit which comprises a pair of coils in each of the lines forming the telephone circuit. These coils are so wound that the induced electromotive forces in them drive current both forward and backward in the line circuit but do not disturb the potential difference of the points from which the grid transformer is fed, provided that the telephone circuit has an equal impedance in both directions reckoned from this feeding point.

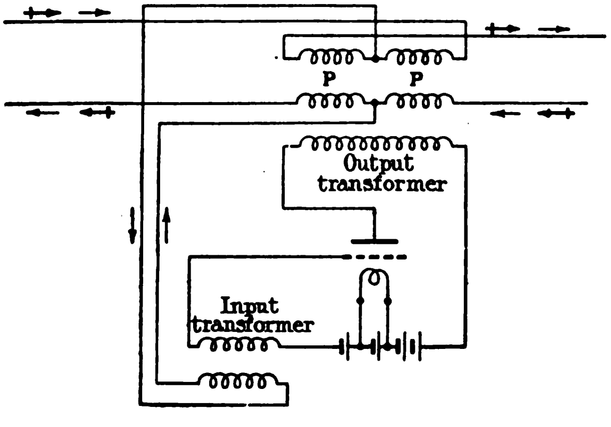


FIG. 10.—TWO-WAY THERMIONIC TELEPHONE REPEATER INSERTED IN A TELEPHONE CIRCUIT, SHOWING MODE OF CONNECTION OF CIRCUITS.

The object of this connection is to prevent the plate current of the valve reacting on the grid and so causing the valve to generate oscillations which would entirely destroy its use as an amplifier. It will be seen, however, that this is only the case when the impedance of the telephone line is equal in both directions from the point of repeating.

(To be continued.)

---

* See *Journal I.E.E.*, 1921, vol. 59, p. 389.

Questions and Answers by Practical Men.

RULES.

QUESTIONS : *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS : *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

Commencing with Question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 177.

I am in charge of a large D.C. motor plant, and I wish to design a starter that will start, in case of emergency, any motor from 5 h.p. to 75 h.p. Can any reader give me some helpful suggestions which can be embodied in the design?—"TESTER."

QUESTION NO. 178.

I am in charge of a 4-pole, $\frac{1}{2}$ h.p. 85 period A.C. motor of the repulsion type. I cannot prevent the excessive sparking which occurs at all loads. Can any reader give me some helpful suggestions?—J. E. WILKINS.

(*Replies to Questions Nos. 177 and 178 must be received not later than March 29, 1924.*]

NOTE.—Owing to an error, Question No. 178, published in our issue of February 29, is identical with that dealt with in Question No. 175. We therefore substitute another question for it.—EDITOR, ELECTRICITY.

Induction Motors.—A book by Miles Walker, Professor of Electrical Engineering in the Faculty of Technology of the University of Manchester, on "The Control of the Speed and Power Factor of Induction Motors," has just been published by Ernest Benn, Limited, at 18s. 6d. net, which is the first to summarise and explain all these recent improvements. The book is fully illustrated with diagrams, graphs, and also with photographs of the latest and best types of induction motors and details.

Diesel Engine Users' Assocn.—At the meeting held on 15th ult. the members considered the committee's report on "Heavy-Oil Engine Working Costs" for the year 1922-23. It was accompanied by a tabulated list of the actual working costs of 29 Diesel or semi-Diesel installations in the U.K. and 5 Diesel Generating Stations overseas. The average total engine cost of the 29 home stations, with a total output of nearly 22,000,000 units, and with an average annual plant load factor of 14.8 per cent., was .987d. per unit generated for the year 1922-23. The corresponding figure for the five overseas stations was .790d. per unit generated. These average figures are obtained from the working of undertakings, in many of which the conditions of working are by no means favourable to obtaining the best results, and they do not represent the results obtainable from heavy-oil engine installations operating under reasonably favourable conditions.

Various Items.

Inst. Ry. Signal Engineers.—The next meeting will be held on March 12, in the I.E.E. building, Victoria Embankment, at 6.30 p.m. Paper: "Electric Signal Machines," by J. Boot.

W. of Scotland Electy. District.—The local Commissioners have decided to postpone the local inquiry until Wednesday, April 23, at 10.30 a.m., and following days, in lieu of the date already announced.

"**Modern Electric Power Stations.**"—This was the title of an interesting lecture given recently at the University College, Nottingham, by Mr. H. Cotton. It was accompanied by several practical demonstrations.

The Engineers' Club.—The following meetings of interest to our readers will be held during March:—11th, Mining and Electrical Engineers; 14th, Inst. E.E., Students' Section; 19th, Inst. of Production Engineers; 20th, Assocd. Municipal Electric Engineers; 21st, Assocd. Municipal Electric Engineers; 28th, Diesel Engine Users' Association.

Chile.—Manufacturers who wish to obtain orders from the Chilean State Railways for:—No. 2 telegraph and telephone materials, tools and instruments and No. 41 (*a*) electrodes for electric welding, may obtain full particulars and inspect the specifications (in Spanish) on application to the D.O.T. 35, Old Queen Street, S.W.1. Quote reference number 6720/FL/GP.

Ex-British Westinghouse Assocn.—The sixth annual reunion dinner will take place in the Royal Venetian Chamber of the Holborn Restaurant, London, on Friday, March 21, under the chairmanship of Sir Holberry Mensforth, K.C.B. Invitations have been issued, and if any member has not received his, would he kindly inform the Hon. Secretary, Mr. L. S. Richardson, 8, Hillside Road, Bushey, Herts.

Fulham.—The Borough Council have accepted the tender of the Metropolitan-Vickers Co., Ltd., at £131,000 for the extension of the present electric light and power plant. This includes the installation of two 6,000-kw. turbo alternators with condensers, three high-pressure boilers with super-heaters, economisers, etc., together with buildings, pumps, switch-gear transformers and other apparatus.

Finance.—The balance-sheet of the Charing Cross E.S. Co. for 1923 shows the continued and healthy progress of this great undertaking, and we congratulate the directors that for the first time they have felt justified in paying a dividend (10 per cent.) on the ordinary share capital of the city undertaking. They are also reducing the price of the current to the consumer, which is most certainly a step in the right direction.

Quotations Wanted.—The Municipal Council of Johannesburg invite tenders for oil switches (Contract No. 225).——The P.M.G.'s Dept. at Sydney, N.S.W., invite tenders for signal cable and insulated wire (Schedule N.S.W. No. 69).——The Argentine Sanitary Works of the Nation invite tenders for the supply and delivery of the electrically driven pumping machinery and materials required for the installation of various pumping stations in the City of Concepción del Uruguay.——The Municipal Council of Johannesburg invite tenders for the supply of recording ammeters. Specifications, etc., at the D.O.T. (Room 52), 35, Old Queen Street, S.W.1.

Meetings.—The Junior Inst. of Engineers will meet on Friday, the 7th inst. Lecturette, "An Introduction to the Study of Fire Danger in Factories, with Some Notes on Fire Insurance," by P. M. Fraser. Also on Friday, the 14th inst., paper, "Water Tube Boilers," by L. M. Jockel (slides); and on Friday, the 21st inst., lecturette, "Sulphuric Acid Plants, New and Old: Constructional Details and Working," by P. Parrish (slides). All at 39, Victoria Street, at 7.30 p.m——The Scottish Centre of the I.E.E. will meet at the North British (Waverley) Station Hotel, Edinburgh, on Tuesday, the 11th inst., at 7 p.m. Paper, "The Design of Apparatus for the Protection of Alternating-current Circuits," by A. S. FitzGerald.

All trade readers who are dealers in wireless should make a point of writing at once to the **Metropolitan Vickers Co.** at Trafford Park, and ask for a copy of the latest "Cosmos" catalogue and handbook Y 7117/1, which contains very full details of the many excellent wireless specialities which are now being marketed by this company and for which there is always a ready demand from private customers. It is, therefore, directly essential that dealers should have good stocks, and for that very reason we advise early application for the catalogue, as it deals with goods for which there is certain to be an excellent demand.

Trade Notes.

We are pleased to hear that the electrical and mechanical improvements recently introduced in the Wild-Barfield automatic hardening furnaces now permit the makers, **Messrs. Automatic and Electric Furnaces, Ltd.**, to increase their efficiency. Whereas the cost of hardening one ton of steel parts with power at 1d. per kw. has been 34s., they are now able to reduce this cost to 26s. per ton. This figure includes the period of one hour required for heating up the furnace from cold to working temperature, and in view of these improvements they will in future give every user of these new furnaces in the U.K. a year's guarantee, replacing free of charge any part of a furnace other than the safety fuse If in the course of twelve months from installation there has been no claim made for replacements, they are prepared to carry forward the guarantee for another six months.

Folder L 307 has just recently been issued by the **British Thomson-Houston Co., Ltd.**, of 77, Upper Thames Street, E.C.4. It is charmingly printed in colours, and deals with the Luxor fittings for domestic and commercial lighting, of which particulars have already appeared in our editorial columns. There is also a price list of silk shades for use with these fittings, and as the folder can be supplied over-printed with the name and address of any contractor or retail dealer who may wish to sell these fittings, the list should be of direct value to a very large number of our readers. Copies may be obtained on the usual trade application.

Leaflet 03184 has just been issued by the **General Electric Co., Ltd.**, and quotes the reduced prices which are now available in connection with the well-known Geekco Accumulators for ignition, lighting and starting purposes. It should, therefore, prove of direct interest to all garage proprietors and trade readers who are in any way connected with the supply and installation of these accumulators to clients in the motor industry.

A striking testimony of the value of the "**D.P.**" **Battery Co.**'s patent "Kathanode" separation is contained in the report of a colliery company, which reads as follows:—"During the past sixteen months the average life of accumulator plates for two-volt miners' electric lamps at this colliery has been ten months. Experiments with the same type of plate fitted with 'Kathanode' separators show up to the present a life of eighteen months. These plates are still in use, and on examination it is estimated that they will last four months longer." "Kathanode" seperation is exclusively used in the manufacture of "D.P." Kathanode batteries for electric vehicles, trucks and locomotives, also for submarines, train lighting and other special purposes.

Sample Pair Sent on Approval for 8/6
Made of Pure Para Rubber soft and durable and unaffected by climatic conditions
DAVID MOSELEY & SONS
Limited.
ARDWICK, MANCHESTER.
MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
A PRACTICAL TRADE JOURNAL

MARCH 14, 1924.

CONTENTS.

PAGE
The "Benson" 3,200-lb Boiler 133
D.C. Networks 134
The Scope for Heavy-Oil Engines 134
British Enterprise at the British Industries Fair 134
Transmission Maintenance of Telephone Systems 134
Henley's Dramatic Club 135
The Design of Apparatus for the Protection of Alternating-Current Circuits 135
The C.T.S. Competition 135
The Benjamin "Dim-a-lite" 136
Current Topics 139
The B.T.-H. at the B.E.X. 140
Armature Reaction and Commutation 141
Electric Lighting at Kirkwall 142
Questions and Answers by Practical Men 142
Problems in Telephony, Solved and Unsolved 143
Various Items 143

THE "BENSON" 3,200-LB. BOILER.

STEAM POWER EFFICIENCY EQUAL TO THE DIESEL ENGINE.

(From a Correspondent.)

The fact has now been made public that the remarkable steam generator invented by Mr. W. Benson, of the Benson Engineering Co., Ltd., 109, Kingsway, London, W.C.2, working at 3,200 lb. pressure and the critical temperature of steam 706 deg. F. (saturation) without the absorption of any latent heat, has now been operated at Rugby under large scale test conditions. The company state that there has been no difficulty, and the initial problem of working at this almost incredible pressure has been solved, representing unquestionably a complete revolution in the production of power by steam, and of vital importance to the generation of electricity.

The Benson generator, one form of which is installed at the works of the English Electric Co., Ltd., Rugby, consists of a series of coils of ¾ in. diameter bore steel tubing, ¼ in. thick, placed round a large vertical inner cylinder of refractory material to a height of about 8 ft. Surrounding this coil is an outer casing of lighter refractories covered with sheet metal, the whole generator being, therefore, between the two walls. Situated over the top are similar coils forming a superheater, the overall dimensions of the entire casing, boiler and superheater being about 17 ft. high and 7 ft. diameter. The generator is heated by oil burners, using heated air to increase the temperature, an arrangement merely for the convenience of experiment. Distilled water is continuously passed into the coils at the bottom by means of a motor-driven hydraulic force pump working at 3,200 lb., the rated maximum capacity of the boiler being 10,000 lb. of water evaporated per hour. As the water travels continuously upwards and round through the coils, it is gradually heated to a higher and higher temperature, the pressure, of course, remaining constant at 3,200 lb. because of the pump, until, when most of the total length of the generator coil has been traversed, the temperature of the water has reached the critical point of 706 deg. F. At this stage, the volume being three times as great as at 60 deg. F., the water is bodily and quietly converted into steam at the same volume without ebullition or the formation of bubbles of steam. During the short remaining period of the travel the steam becomes slightly superheated to about 720 deg. F., and is then reduced by a special reducing valve, in which process the temperature drops to about 620 deg. F. and passed into the superheater, where the temperature is raised again to approximately 850 deg. F., the final pressure being 1,500 lb. This steam is then to be utilised in a small very high-pressure steam turbine, now under construction, running at 20,000-25,000 revs. per minute, exhausting at 200 lb., generating about 350 kw. into an ordinary condensing turbine after reheating, which gives a further 900 kw., making a total of 1,250 kw. as a condensing set for ordinary running, although the overload capacity is much better.

As a matter of fact the construction of a turbine to-day for this duty presents comparatively few difficulties, and half a dozen different turbine firms would build and guarantee such an installation of very large size, whilst it is very likely speeds such as 3,000 revs. per minute will be possible. The revolutionary feature of the Benson steam generator is that we can now use steam at several thousand pounds per square inch because the inherent difficulties of the coil steam generator have been entirely eliminated. Under ordinary conditions, because of the absorption of latent heat and the fact that particles of water are thereby suddenly converted into comparatively large bubbles of steam, the water in a narrow bore coil, say, less than 1 in. diameter, will not stop in contact with the sides of the tubes, and the whole contents tend to be blown out explosively, the generation of the steam being erratic and spasmodic. In the Benson boiler the highly ingenious principle is adopted of going right up to 3,200 lb. when no latent heat of steam is required at all, so that no ebullition takes place, and the whole mass of water, as distinct from individual particles, is quietly converted to steam in quite a different manner to ordinary boiling.

There is no need to emphasise the enormous economy to be obtained by generating steam at several thousand pounds pressure. This will be evident on consulting a series of Rankine cycles plotted for different pressures, using one total heat for comparison, on temperature entropy diagrams, or of adiabatic expansions according to the Mollier heat entropy diagram. Thus, for example, taking the most modern super-power power station at 350 lb. and 700 deg. F. superheat, this is running at perhaps 17 to 18 per cent. efficiency from the coal, whereas the "Benson" boiler for an ordinary large station would give 28 to 30 per cent.—that is, the coal bill would be reduced by about 35 per cent., the thermal efficiency, using a pulverised fuel flame for heating, being equal to the Diesel engine, which requires expensive oil fuel. Finally, the element of danger is infinitesimal. The coils have been tested by the insurance company to a hydraulic pressure of 6,400 lb. per square inch, and, even if a burst took place, the total water content is so small that little damage could result. It is understood that the details of the test results will be available shortly and important developments are pending.

D.C. NETWORKS.

At the meeting of the Informal Section of the I.E.E. on Monday, March 3, Mr. E. F. Hetherington was in the chair when Mr. R. D. Spurr opened a discussion on D.C. networks. Mr. Spurr said it was his intention to show that D.C. networks are not as bad as they are reported to be, and do not deserve the wholesale condemnation they receive. They are being scrapped everywhere to-day, but there is not always justification for it, nor is the A.C. system that is substituted as efficient as is sometimes claimed for it.

He described a typical D.C. system designed for a purely lighting load, and now complicated by a considerable growth of industrial users.

He showed the appalling cost involved in changing over much of the apparatus connected, and, further, the prohibition from opening roads and private grounds for laying new cables, and he then spoke of his methods of grappling with this problem.

Mr. Spurr warmly advocated the use of rotary converters of 500 kw. minimum capacity as being the best solution.

In the subsequent discussion, which showed the meeting to be mainly in disagreement with the opener, the mercury rectifier was discussed at considerable length, and the general opinion seemed to be that this invention is a most valuable contribution to the solution of the difficulties the opener described. Mr. Spurr's own opinion of it is that it is not yet at its best development.

Messrs. H. Craske, R. Grierson, A. F. Harmer, E. F. Hetherington, A. G. Hilling, R. V. Hook, C. M. Mayson, and A. H. E. Tomkinson spoke, and Mr. Spurr, in concluding the debate, agreed that, if he were starting afresh, he would adopt a three-phase four-wire system of distribution.

THE SCOPE FOR HEAVY-OIL ENGINES.

Mr. A. W. A. Chivers, in thanking the members of the Diesel Engine-Users' Association for electing him as president for the current year, referred to the useful nature of the work carried out by the association in recent years, which he thought was greatly due to co-operation existing between all parties interested in Diesel engines and other heavy-oil engines. He considered that the assistance given by the engine manufacturers to users was very valuable, and that there was a great future for the association. The realisation of the merits of the Diesel engine had led to a rapid rate of progress, and at the present time there were grounds for being even more hopeful than in the past as to the future of the heavy-oil engine for land purposes, especially for the generation of electricity. There was a time a few years back when practically the only type of generating plant that was talked about was the type which was considered suitable for super-power stations, and many people at that time were very much concerned lest the powers which were granted to the Electricity Commissioners should be exercised in a direction which would preclude the use of the Diesel engine. There were not the same grounds nowadays for the feeling that there would be undue restrictions on Diesel engines for the purpose of generating electricity that there were, say, two years ago. His view was that the policy of erecting super-power stations in this country was right, but that the scheme had yet to be developed. As the population of this country became still more dense, there would undoubtedly be very strong grounds for taking supplies from a super-power station, but that day, in some districts, had not yet arrived. There would always be scope for heavy-oil engines for the generation of electricity in the more sparsely populated districts, especially in those where electric supplies were to be developed, and there were certainly many places in this country where, if a scheme was considered and dealt with on its merits, it could be shown that a supply of electricity could be given to the public at a cheaper price by means of such plant than could be done from super-power stations, because the one big factor that was so frequently omitted by advocates of the super-power station was the cost of transmission.

BRITISH ENTERPRISE AT THE BRITISH INDUSTRIES FAIR.

Work has now commenced on the actual erection of this year's British Industries Fair, which, as in the past, is being organised by the D.O.T. The London section will open on April 28.

The interest the Fair has excited, especially from buyers overseas, is evidenced not only by the record number of pledges to attend, but by the fact that many buyers will be coming from countries which have not been represented at previous Fairs. Ecuador, Syria, China, Algeria, the Canary Isles, the South American Republics, and a score of other remote places, in addition to those better-known commercial countries who are represented every year, will be represented at the forthcoming Fair, and leave no doubt of a record attendance of visitors anxious to place orders for British goods.

TRANSMISSION MAINTENANCE OF TELEPHONE SYSTEMS.*

By P. E. Erikson, I.E.E., and R. A. Mack, A.M.I.E.E.

Summary.

This paper is divided into two parts. The first part deals with the broad aspects of modern telephone transmission maintenance, the economic justification for good maintenance, and the general lines upon which it should be carried out. The second part gives the theoretical considerations leading up to the development of a series of testing instruments, by means of which transmission losses in any part of the telephone system can easily be measured. This part also contain brief descriptions of the instruments and their use.

---

* Summary of paper read before the Inst.E.E.

HENLEY'S DRAMATIC CLUB.

At Cripplegate Institute, the above club successfully played the humorous farce entitled "The Magistrate," by Sir A. Pinero. It was a fine night on Friday, March 7, and the pleasant hall was extremely well attended by a most enthusiastic audience

The play was carefully produced by Mr. Henry Thornton, and the acting was highly creditable to all concerned, the enunciation being excellent. No doubt the palm could be given to Mr. F. Bettley, who sustained the character of the title with splendid energy; while Mr. Turner and Mr. Edney acted admirably, and Mr. Gibbs was distinctly funny. Of course, the ladies were charming, and the police true to life. Very pleasant music was contributed by the Audbrook Trio.

THE DESIGN OF APPARATUS FOR THE PROTECTION OF ALTERNATING-CURRENT CIRCUITS.[*]

By A. S. FitzGerald, A.M.I.E.E.

The paper deals with differential protective systems, particularly those suitable for use where there is a neutral earthing resistance.

The operating conditions, and their influence on methods of design and construction, are discussed, and improved means of practically applying the various protective circuits are described.

The superiority of biased systems, in principle, is accepted as having been established, but the objections to a more complicated relay are recognised. The author advocates the use of simple relays only, in order to restrict to a minimum the employment of moving parts associated with small amounts of power.

The necessary functions peculiar to biased and certain other protective systems have led to the use of balanced beam, dynamometer, and other special forms of relay. The paper describes how these features may be achieved with a simple relay and a static device called a "biasing transformer."

Current transformers and simple types of relay are briefly dealt with, and a further static device called a "phantom auxiliary switch" is described.

The application of the foregoing apparatus to actual protective circuits is described in the second portion of the paper, and attention is drawn to the advantages of dealing with earth faults and line faults independently.

The Table of Contents is as follows:—

Introduction.

SECTION 1.

General features of design.

Reliability. Conditions of service. Range of operation. Responsibility. Limitations of protective circuits. Stability. Biased systems.

Static method of providing bias.

The biasing transformer. Overload restraint. Discriminating restraint. Directional operation. Auxiliary restraint.

Construction of the biasing transformer.

Protective transformers.

Protective relays.

Anti-surge device. Augmented contact pressure. Resonant relay.

Other components of a protective circuit

Phantom auxiliary switch.

SECTION 2.

Protective systems.

General. Generator protection. Transformer protection.

Feeder protective systems.

Opposed voltage system. Discrimination between line faults and earth faults. Circulating-current feeder protection. Split-conductor protection.

Parallel feeder protective systems.

General. Balanced-current system. Operating conditions of balanced-current gear. Improved form of balanced-current circuit. Balanced-power system. Operating conditions. Improved form of balanced-power circuits. Use of dynamometer relays.

Application.

Conclusion.

The complete paper will, we are certain, prove of direct interest to all readers who are intimately associated with the control of alternating current plant and distributing systems.

THE C.T.S. COMPETITION.

The third prize was awarded to Mr. H. Alder, and of his paper Mr. Highfield writes:—

This paper describes the application of the C.T.S. system to one installation, and as far as it goes it is good. The author has given thought to the merits and demerits of the system, and the criticism is constructive. It is a pity that the author did not go further and deal with the general application of the system with a summary at the end. It is difficult to use an expression to describe this paper, because, although it is good, it does not fully cover the subject. The marks given are 45 per cent.

THE C.T.S. COMPETITION.

As we have this last year started using the C.T.S. wiring system on our work at Colchester, at which place we have already many kinds of wires, I should like to say one or two points about it.

Here we have a good many stables and places where our wiring comes in for some rough use. As you know in stables the places are very damp, and we have found it a hard job to keep the wiring so that it shows a good test. Here, it seems to me, that in using the Cab Tyre we have the right kind of wire for the job, for, if we look at our casing, we find that it is all damp, and that we can get shocks from it. Even the conduit will not stand long, as the wires inside it get wet; but so far the Cab Tyre, when it gets wet, it does not seem to go, and a bad test can be traced to the flex and a little at the junction boxes. It also seems that it will stand a bigger overload for a time.

But still there are one or two things which are not as good as the wire on the system: one is that the junction boxes are not so nice as they should be; they are too round, and stand out too much. They look as if they should not be there. Of course, I am now looking at surface work, of which we have a lot. It seems that if they had been made on the cleat rose system, and long instead of round, it would have been better. The wires would then enter at the end of the boxes. Then, again, the screws in the terminals should be more on the slope, as now it is sometimes hard to get two wires under them nicely.

---

[*] Summary of paper read before the I.E.E.

We have a lot of cleat work, and in looking at the plain two- or three-wire work I must say that cleat work looks better than the C.T.S; even the lead-sheathed looks neater. This is, I think, to be found in the look of the cleats and clips. The clips on the C.T.S. seem to be too small and all to one side, and, as we have to use more clips on cab tyre, it looks all clips. If they were made like the clips used on lead wiring it would be better and neater.

On one part of our works we have two large baths of boiling caustic soda, about 5 ft. by 2 ft. These are boiling all day long, and fumes from these eat the wires right away, so that we have put some Cab Tyre up, and so far all is going well.

One thing where the C.T.S. is better than the conduit or the casing system is in its junction boxes, for we can when we have trouble find a place where we can test our wires with a lamp; also, we can cut out the bad circuit, and so save a large number of joints for the time; also, we can use shorter lengths of wire without joints.

A lot of our mains are overhead wires, and in using Cab Tyre for the leading-in wires we have no braid, and so not the danger of leakage. The sheath seems to make the wire stronger; but here, I think, is wanted a rubber thimble to fit over the ends, so that we have no cut rubber sheath on which the weather can act, as this would keep the rubber longer.

We have some dining halls which are so damp that the tops of the lamps get eaten right away, and, when we take the lamps out of the holders, the water runs down the glass. This causes a good many shorts in the flex, holders and lamps, so we have now got to remove the flex, and wire Cab Tyre in its place. Also, to seal the tops of the lampholders with compound. So, here again, we feel sure that the C.T.S. will do its work. We have many places in which we are about to try Cab Tyre.

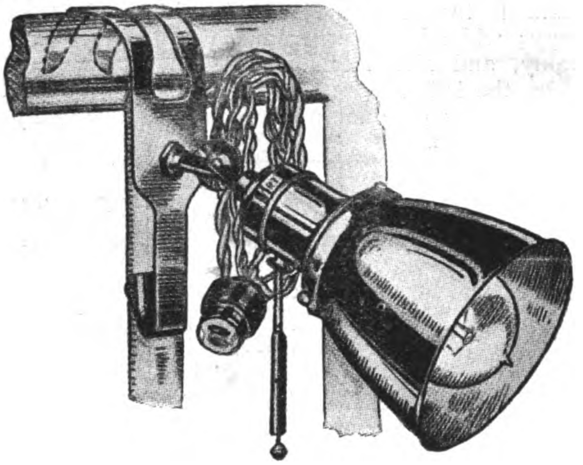
"THE MANUFACTURE OF THE INCANDESCENT ELECTRIC LAMP."

On Friday, February 29, Mr. W. A. Rhind, M.I.S.I., delivered a lecturette on this subject before the members of the Junior Inst. of Engineers. In it he described the preparation of the tungsten filament and other components of the electric lamp, and gave a full account of the method of their assembly in the vacuum lamp as well as in the ordinary and the pipless gasfilled lamps. Particulars of the pumping and gasfilling operations were given. The various shapes of filaments were distinguished, and the lecturer concluded with a short note on the manufacture of carbon filaments.

An interesting discussion followed, in the course of which the lecturer explained the advantages of the pipless lamp, and answered questions relating to the ageing and blackening of lamps, and also questions about neon lamps and tubes.

THE BENJAMIN "DIM-A-LITE."

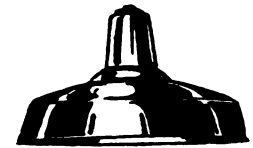
The annexed illustration shows the portable "Dim-a-lite" lamp which is being manufactured by the Benjamin Electric, Ltd., the well-known illumination experts. The illustration really speaks for itself, and shows clearly how the fitting can be adapted for the bedside, nursery or hospital, and the makers claim that it is the only successful "turn-down" attachment for electric light which can thus be turned up or turned down "just like gas." The apparatus is really a compact rheostat, fireproof and unbreakable, while the operation is most simple, it being necessary only to pull the cord for the different changes of light, viz., full, half, dim, nightlight and out. The resistance wires and contact bars are embedded in a solid fireproof composition, which prevents the wires from corroding and ensures long life. Finally, a certificate issued by the National Physical Laboratory proves definitely that the "Dim-a-lite" is an actual means of saving current. The apparatus is, therefore, one which should find a ready sale among contractors, and retail dealers in electrical goods generally, especially when it is remembered that they can be supplied for either high or low voltage.



Electric Welding.—The Inst. of Welding Engineers will meet in the Lecture Theatre of the Municipal Technical School, Byrom Street, Liverpool, on Monday, the 17th inst., at 7.30 p.m. Lecture, "Steel: Its Properties and Their Relation to Welding," by Prof. F. C. Thompson, B.Sc., D.Met. A demonstration of electric arc and oxy-acetylene welding will be given between 6 and 7.15 p.m., and all those interested in the processes are cordially invited to be present.

The E.D.A. Luncheon.—At the annual luncheon of the Electrical Development Association, which is due to be held at the Hotel Cecil on the 21st inst., speeches are to be made by the President-Elect of the Association, Mr. Alderman W. Walker, M.I.E.E., and also by Sir James Stevenson, Bart., G.C.M.G. (B.E.X.), Sir Malcolm McAlpine, K.B.E. (B.E.X.), Mr. Emile Garcke, M.I.E.E., President B.E.F., and Mr. S. R. Allen, M.I.E.E., Chairman E.D.A.

Motor Ships.—The advantage of increased cargo-carrying capacity which is obtained by installing oil engines in ships instead of steam machinery is well instanced in a comparison published in this month's *Motor Ship* between motor vessels and steamers of exactly similar dimensions and engine power. There is also a most interesting article on the Diesel electric drive for ships, a brief description of the Diesel electric ferry-boats in use at San Francisco, and a full account of the motor yacht *Vanadis*, which has a very large amount of auxiliary electrical machinery.



Don't worry!
THERE IS A
BENJAMIN
REFLECTOR
for
EVERY CLASS of
LIGHTING
INSTALLATION.

Advert. of the Benjamin Electric Ltd., Brantwood Works, Tariff Road, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and Abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Tuesday morning, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No.: 2460 Gerrard.

Current Topics.

Electric Light at the Coal Face.

In the light of Dr. W. M. Thornton's recent interesting paper on electrical risks below ground in fiery pits, there would appear to be no insuperable difficulty in illuminating mine workings much more effectively than by the present feeble glimmer incidental to the regulation safety lamp, whether oil or electric, carried by the individual miner. A large percentage of the accidents which at present occur in coal mines are either directly or indirectly due to the absence of efficient illumination, without which it is practically impossible to foresee certain classes of mishap. The experienced miner must acquire a species of sixth sense, which enables him to preserve his safety under the conditions at present prevailing, and it is evident that, given underground illumination based on scientific observation of the intensities required for various classes of work, mining would become a much safer occupation, whilst the efficiency of coal-getting would be correspondingly increased.

On Dr. Thornton's showing, there need be no risk incurred by introducing electric light throughout any colliery workings, even into the farthest corner of the most fiery mine. At comparatively high frequencies, of the order of 160 cycles, single-phase alternating current up to 175 amperes, at 15 volts, has been interrupted in the presence of a most explosive air-gas mixture without firing it. With such a current available, even at the low supply pressure of 15 volts, considerable illumination of extensive workings is possible when using gasfilled bulbs and properly designed fittings and reflectors. Before the possibilities opened up by Dr. Thornton's experiments are put into practice, there will naturally be considerable prejudice to overcome. The mining fraternity are essentially conservative, and rightly so, having regard to the risks attendant upon their daily occupation. It must be demonstrated, and without delay, that the new electric lighting of coal-pits means greater safety, instead of, as some may argue, an increase of the risks attendant upon coal-getting.

It now remains for some influential combination, representing the joint interests of coal owners and miners, first to satisfy themselves of the truth of Dr. Thornton's claims, and then make the necessary representations to the Mines Department of the Government to secure authority to instal electric lighting on his system in one or more pits for the necessary trial period, during which valuable observations and data could be compiled, demonstrating once and for all that the proposed new system of mine-lighting should be universally adopted as soon as practicable throughout the coalfields of this country. It is significant that the coal-mining Press, including the official organ of the Association of Mining Electrical Engineers, is in favour of the scheme, as making for "Safety First."

Those Batteries.

Apropos of my comments a week or two back on the mystic letters "C.O.V." as applied to accumulator acid in the storage battery maintenance hints issued by a well-known firm of accumulator manufacturers, it will be remembered that I translated the abbreviation as "Commercial Oil of Vitriol." I was in error, as the real meaning is "Concentrated Oil of Vitriol." The incident bears out my contention that all literature intended for the information of the lay public should be expressed in the most elementary and comprehensive language, and in a letter from the publishers of the information above referred to it is admitted that the term "C.O.V." was rather above the heads of those battery users for whom the folder was intended—a defect which is to be remedied in future editions.

A British Contract for British Labour.

Congratulations to Fulham Borough Council upon its decision to accept the tender of a British firm for electrical plant to the value of £131,000, in face of a competitive Swiss tender no less than £12,000 lower. In coming to this praiseworthy decision, the Fulham Council have adopted a sound policy, for, in spite of the apparent saving of £12,000 which they would have effected by placing the contract in Switzerland, they would probably have involved Fulham ratepayers in a far larger sum by way of unemployed grants and "dole" taxation, if not directly, at all events indirectly. The contract further provides that every part is to be of guaranteed British manufacture, a condition which precludes the practice of sub-contracting to foreign firms for portions of the plant. It is to be hoped that the lesson of Fulham will not be lost on Bradford and other municipalities guilty of the narrower parochial view that the saving of a few hundreds of pounds in capital expenditure by going abroad is really to the benefit of the taxpayer in the long run

A Novel Suggestion.

There is much to be said both for and against the proposal of the City of Sydney, New South Wales, to effect a temporary interchange of technical officers in the electricity department with those on the staff of the Leeds Corporation electricity system. In his letter making the proposal, the Town Clerk of Sydney states that his Council has adopted the principle of sending technical officers abroad to obtain the latest information regarding large electricity undertakings outside Australia, and suggests that it might be mutually advantageous if an interchange of officers could be arranged with Leeds. The matter has been deferred for consideration by the Electricity Committee. It is a perfectly sound suggestion, which, if carried out on a wholesale scale, would do much to extend the knowledge and add to the experience of power-station engineers throughout the Empire. The only objection I can see is that, if universally adopted, some of our most promising young engineers might be tempted by the greater opportunities in the lands of their temporary adoption, and seek to become permanent residents of the various Colonies and Dependencies.

Already there has been an outcry anent the loss of so many of our skilled craftsmen to countries abroad, which offer them better opportunities than the homeland, and in most instances the ambitious worker is only deterred from taking the plunge of emigrating by the difficulty and expense of getting out to the land of his desire. Once on the spot, his difficulties are overcome, and he has endless opportunities of proving whether there are greater chances for developing his talents than at home. In the case of a visiting engineer, the temptation to remain in such circumstances would be very strong. On the other hand, such visitors to our oversea dominions would be acquiring invaluable experience besides broadening their knowledge of the world and its people, and their resultant value to their present employers would necessarily increase as a result of such knowledge, so that, if the scheme is adopted, Leeds and other undertakings would have to face the prospect of suitably rewarding their chosen staff upon its return from the Antipodes.

What the "Juice" is It?

I have often wondered at the state of mind many wireless and other amateurs, with no knowledge at all of electrical matter, must get into when they tackle descriptions which are the least bit involved—especially when weird names not in the ordinary dictionary are suddenly hurled at their heads. But there are times when many of us who ought to know better get puzzled, sometimes with reason, though at other times (and I say this with sorrow) to our own disgrace. Consider, then, the awful plight of Crediton Urban Council the other day. They were thinking about Exeter's offer to supply electric power—a useful and welcome proposition. But there was a snag. Exeter's terms were stated to be "£12 per kilowatt per load." No wonder the chairman said it was "double Dutch." Even their electrical engineer couldn't get the hang of it, and if *he* couldn't, what chance had the councillors? However, in the meantime Crediton is thinking about being independent and generating its own electric power.

And talking of electrical misnomers, here's "20th Century Advertising" orating about "Great Batteries of Looms driven by Electric Dynamos in full swing." What an impressive picture! But it only makes *us* grin. I particularly like the "full swing" part. At first, though, I thought it was our ancient friend and puzzler Mr. Perpetual Motion back again in the guise of the motor-and-dynamo that keep each other going for ever. And here's another bit of graphic writing. It is our old, old acquaintance "Ratepayer" laying a complaint before the local paper. He has a bone to pick with the Electric Supply Department, and this is how he tells them off. "*What is wanted*," he says with tremendous sarcasm, "*is to install a live wire to push things along a little more quickly.*" If that doesn't make them 'em sit up, I don't know what will. I've seen a live wire do a lot of things, but not quite *that!*

Elektron.

THE B.T.-H. AT THE B.E.X.

A GLIMPSE THROUGH THE PORTAL OF THE BRITISH THOMSON-HOUSTON COMPANY'S STAND IN THE PALACE OF ENGINEERING.

Some idea of the magnitude of the British Empire Exhibition can be obtained from consideration of the attention which has been bestowed on the structural details of the stands now being erected in the electrical Section of the Palace of Engineering, and the accompanying illustration gives an impression of the British Thomson-Houston Company's exhibit. At first sight it would appear to be a view of one of the pavilions in the Exhibition grounds, but it is itself a small exhibition, complete in every detail. It occupies a floor space of over one-seventh of an acre, and includes such exhibits as a complete automatic sub-station; a large synchronous motor driving an air-compressor; an oil circuit-breaker for outdoor use on three-phase circuits of 110,000 volts, and a wide range of other breakers for numerous voltages and rupturing capacities; many examples of switch and control gear for various industrial purposes; trolley 'bus, railway and tramcar equipments, etc. Among the smaller exhibits are such items as Mazda lamps, lighting fittings and radio apparatus. The stand, which is situated in Avenues 9-10, Bays 11-15, is adjacent to the Central Lounge, and the company claim that it will be easily detected by the effective manner in which the imposing structure is illuminated.

Not only are examples of this company's extensive range of products to be found on this stand, but B.T.-H. motors and control equipments are driving machinery of every description in nearly every building throughout the Exhibition. The model colliery is equipped with complete electrical winding gear, and the power house and sub-stations contain B.T.-H. turbo-generating plant, rotary converting plant and switchgear.

ARMATURE REACTION AND COMMUTATION.

By G. WINDRED.

(Concluded from page 123.)

ELIMINATION OF SPARKING.

(1) In the first instance, for the sake of clarity, we will investigate the simplest case of commutation, in a two-pole machine, where the width of one brush is sufficient to cover two segments of the commutator only. We will also assume that the armature coils do not possess inductance, and that commutation occurs in the neutral magnetic zone.

If r_1 is the resistance between the brush and the entering segment of the commutator,

r_2 the resistance between the brush and the trailing segment,

R_c the total contact resistance of the brush,

T the time of commutation,

t the time from commencement of commutation,

we have, neglecting the variations in contact resistance with varying current density,

$$r_1 = R_cT/t, \; r_2 = R_cT/T-t.$$

Similarly, if the current in one branch of the armature is denoted by I, a current of 2I enters the brush as shown in Fig. 4, and divides into two portions, flowing through each half of the armature. We may, therefore, say that:—

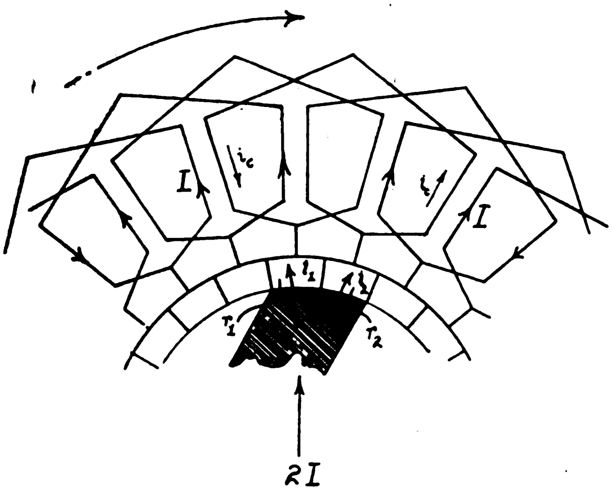


FIG. 4.

$$i_1 = I - i_c, \; i_2 = I + i_c$$

where i_1 is the current in the entering segment of the commutator.

i_2 is the current in the trailing segment, and i_c the current flowing in the short-circuited coil at any moment t during commutation.

Neglecting the small resistance of the coil, we also have

$$i_2 r_2 - i_1 r_1 = 0.$$

Substituting the values already found for r_1, r_2, and i_1, i_2, it is obvious that

$$[(I + i_c) \; (R_cT/T-t)] - [(I - i_c) \; (R_cT/t)] = 0,$$

and solving for i_c we now obtain

$$i_c = I - [2I \; (t/T)],$$

from which it will be seen that the sequence in the short-circuited coil is as follows:

$$\text{When } t = 0, \quad i_c = I$$
$$t = T/2, \quad i_c = 0$$
$$t = T, \quad i_c = -I$$

This, of course, is the ideal condition for commutation, since the short-circuit current in the coil passes through its zero value at time $T/2$ from the commencement of short-circuit. We thus obtain a straight-line short-circuit curve as shown in Fig. 5, where t is plotted along the horizontal axis $O\,T$, and i_c is represented by the ordinates $O\,I$ and $O - I$.

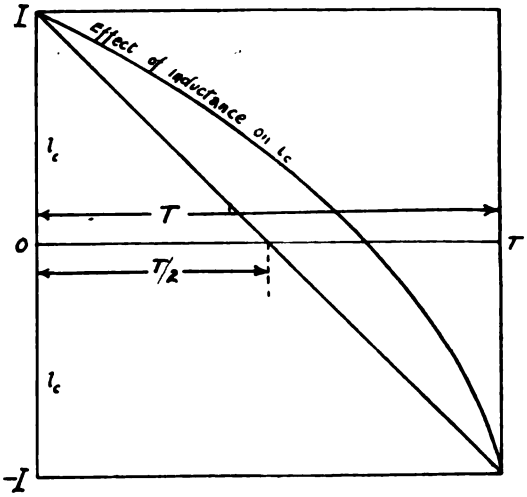


FIG. 5.

Since the contact area of the trailing tip of the brush is proportional to $T - t$ the current density under it is also proportional to $i_2/T - t$.

It is obvious, therefore, that with these conditions the current density under the brush is constant at all periods during commutation, so that no sparking is possible if the brushes are of adequate cross-section, since the current density under the trailing tip decreases proportionately with the contact area.

(2) Condtitons existing in actual practice, however, differ materially from those already investigated, owing, chiefly, to the effect of the inductance of the armature winding.

The effect of the inductance of the armature coils on the short-circuit curve will be seen from the diagram, Fig. 5, where the current is represented by the curve which passes through its zero value at t much later than $T/2$, the reason for this, of course, being that the short-circuit current flowing in the coil undergoing commutation is unable, owing to the inductance, to collapse and change instantaneously. If the commutation takes place at the neutral magnetic axis, therefore, sparking will occur at the trailing tips of the brushes.

To neutralise this effect the angular advance of the brushes is increased so that a sufficiently strong flux is allowed to induce a current in the opposite direction to that flowing in the short-circuited coil.

For an unvarying normal load, the brushes may be adjusted to the best conditions of commutation, but it is obvious that in cases where the load fluctuates a fixed brush position would be ineffectual. In such cases interpoles should be used.

The actual shape of the short-circuit curve may be obtained in various ways, but since it is a purely theoretical procedure one method should here be sufficient.

If the E.M.F. of self-induction be denoted by E_1 which flows in the same direction as i_2 in Fig. 4, we know that

$$E_1 = i_2 r_2 - i_1 r_1.$$

The value of E_1 may also be expressed as $L \frac{di}{dt}$ and by substituting for r_1 and r_2 as already found, we have

$$L \frac{di}{dt} = i_2 (R_c T/T-t) - i_1 (R_c T/t).$$

From the above formula we now obtain

$$\frac{di}{dt} = (R_c T/L) \left[(i_2/T-t) - (i_1/t) \right],$$

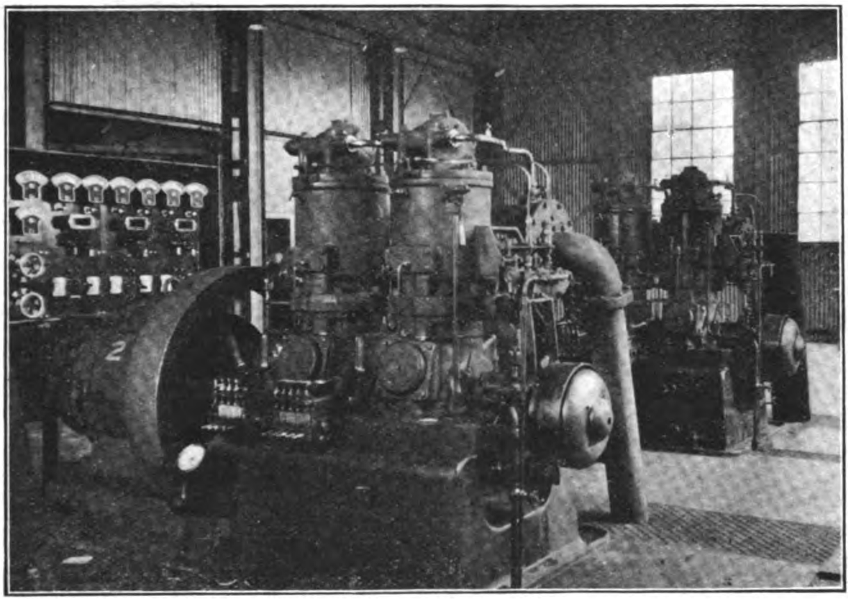
the solution of which determines the shape of the short-circuit curve.

Further methods of procedure are to be found in more specialised treatises on the subject, and should be referred to.

In conclusion, it is hoped that the foregoing notes, although purely elemental and representative of the simplest cases, may involve sufficient considerations to be useful in practical problems.

ELECTRIC LIGHTING AT KIRKWALL.

The annexed illustration shows the interior of the "farthest north" electric light station in Great Britain, which has just been completed at Kirkwall, under the supervision of Mr. James A. Liddle, of Edinburgh. The station building is 64 ft. long by 60 ft. wide over the annexe, with 6 by 6 red flooring tiles and suitable concrete channels covered with steel plates. The prime movers are three sets of semi-Diesel crude or gas-oil engines, each of 65 b.h.p., supplied by the Campbell Gas Engine Co., Ltd., of Halifax. They start on compressed air, and are fitted throughout with splendid lubricating arrangements of the visible type. The dynamos, which were made by the Lancashire Dynamo and Motor Co., Ltd., are each of 40-kw. capacity, and are driven direct from the hub of the engine flywheel at 350 revs. per minute. Current at a pressure of 440 volts will be supplied on the direct-current three-wire system for power and heating, and 220 volts for lighting. There is a switchboard 18 ft. long by 9 ft. high, erected by the station staff, under the direct supervision of Mr. Liddle, and fitted with all the necessary equipment for efficient working; and, as a stand-by, there is a Pritchett and Gold and E.P.S. storage battery of 400-ampere capacity at the 10-hour rate. Altogether the installation is one of which the inhabitants of Kirkwall feel very proud. Mr. Liddle, the consulting engineer, is a native of Orkney, but has been in business in Edinburgh for many years, and has earned worthy distinction in the Scottish electrical field.



Questions and Answers by Practical Men.

RULES.

QUESTIONS : *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS : *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

Commencing with Question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION No. 177.

I am in charge of a large D.C. motor plant, and I wish to design a starter that will start, in case of emergency, any motor from 5 h.p. to 75 h.p. Can any reader give me some helpful suggestions which can be embodied in the design?—"TESTER."

QUESTION No. 178.

I am in charge of a 4-pole, ½ h.p. 85 period A.C. motor of the repulsion type. I cannot prevent the excessive sparking which occurs at all loads. Can any reader give me some helpful suggestions?—J. E. WILKINS.

(Replies to Questions Nos. 177 *and* 178 *must be received not later than March* 29, 1924.]

The South African Power Engineer.—Congratulations to this remarkably well edited South African paper on its seventieth monthly issue. Formerly known as *The South African Engineer and Electrical Review*, it is now owned and controlled by the S.A. Mining Journal Syndicate, Ltd., and in its latest form presents a very live appearance which should assure it a wide circle of readers throughout the Union, especially at the modest subscription price of 6s. 6d. per annum. It is full of articles of direct interest to electrical engineers. Good luck to it!

PROBLEMS IN TELEPHONY, SOLVED AND UNSOLVED.*

By PROFESSOR J. A. FLEMING, M.A., D.Sc., F.R.S.

(*Continued from page* 131.)

It is seldom possible to secure this symmetry, and hence in the practical arrangement the telephone line is cut at the repeater station, and each part is continued by an artificial line which exactly imitates in impedance that respective portion of the arriving or departing line. Each junction is then provided with its thermionic repeater connected as in Fig. 11, and the amplified currents from one line, say, *Line East*, are transferred to the other side, say, *Line West*, and *vice versa*. Hence we have a perfect symmetry of repeater and a circuit which can be used in either direction.

The repeater therefore produces an amplification of the telephone currents which more or less annuls the attenuation of the line.

This is called the "repeater gain" and is reckoned in miles of standard cable. Thus we may say that a certain repeater is equivalent to 15 M.S.C., which means that if inserted in a line whose equated length was 40 M.S.C. it would reduce it to the equivalent of 25 M.S.C. as far as telephonic speech is concerned.

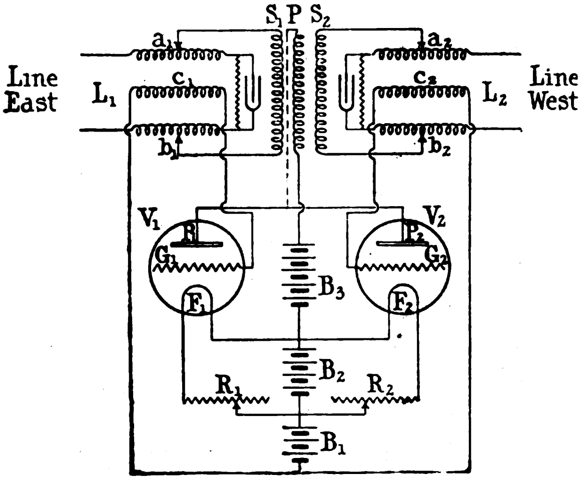


FIG. 11.—MODE OF CONNECTION OF TWO THERMIONIC TELEPHONE REPEATERS IN A TELEPHONE LINE SO AS TO SECURE DUPLEX TRANSMISSION WHEN THE REPEATER STATION IS NOT AT THE ELECTRICAL CENTRE OF THE LINE.

The effect, then, in practice of the introduction of this type of repeater has been to enable a great reduction to be made in the weight of copper used per mile in trunk lines, because the repeater can nullify line attenuation. Thus the London to Glasgow aerial trunk telephone lines employed a double copper conductor each weighing 600 lb. per mile; in other words, the whole 450 mile length involved the employment of 540,000 lb., or nearly 250 tons of copper. We may contrast with this the recently laid underground trunks from London to Manchester, 183 miles long, which were completed last year by the Post Office. This line has been equipped with repeater stations, and the copper conductors weigh 40 lb. to the mile in place of the 300 lb. which would have been necessary without repeaters. This fact alone shows the enormous economy in first cost which could have been effected in the trunk-line telephone system of this country if the thermionic repeater had been in existence when they were first projected.

The completed invention of the thermionic repeater has rendered commercially possible a vast extension of telephonic range, and the establishment of telephone exchanges which may extend over the area of empires or continents rather than cities or countries as suggested by our President, Mr. Gill, in his valuable Presidential Address at the beginning of this session.

(*To be continued.*)

---

*Lecture delivered before the Institution of Electrical Engineers, to whom we are indebted for the illustrations.

Various Items.

Tenders Accepted.—The M. and S. Rly. (Midland Section) have accepted the tender of the G.E. Co. for the supplies of train-lighting lamps for the period ending June 30, 1924.

E.D.A. Sales Conference No. 7.—The next Sales Conference (the seventh) will be held at the London School of Economics, on Friday, March 21, at 7.30 p.m., when Mr. E. E. Hoadley, M.I.E.E., of the Maidstone Electricity Supply, will read a paper on "Electricity the Real Domestic Help." Mr. A. G. Beaver will be in the chair.

I.E.E. Western Centre.—The next meeting will be held at the South Wales Inst. of Engineers, Park Place, Cardiff, at 4.30 p.m. on Monday, 17th inst., when there will be an address by President of Institution, Dr. Alexander Russell, M.A., D.Sc., F.R.S., followed at 6.10 p.m. by a dinner at the Royal Hotel, at which the President will be present. Ordinary dress.

Finance.—The report of the County of London E.S. Co., Ltd., for 1923 is another piece of good news for shareholders in electric light undertakings. The directors propose to pay a final dividend of 8 per cent. on the ordinary shares, making 12 per cent. per annum, together with a bonus of 3 per cent., and after making ample allowance for taxation and reserves, a balance of over £118,000 will be carried forward.

Quotations Wanted.—The P.M.-G.'s Dept., Perth, Western Australia, invite tenders for accumulators.——The Dept. of Sanitary Works of the Nation (Obras Sanitarias de la Naçion) at Buenos Aires invite tenders for the supply, delivery and erection of the machinery and materials required for an electric power-station to be installed in the town of Concepcion del Uruguay. Specifications, etc., at the D.O.T. (Room 52), 35, Old Queen St., S.W.1.

Portugal.—According to last week's issue of the *Board of Trade Journal*, very little British electrical machinery goes to Portugal, although the demand is considerable. In this line only the cheapest product is bought, as a general rule, but 1922 showed an increase in the import of British D.C. generators. What the country really needs is cheap power, and this may eventually be forthcoming, because Portugal has both coal and hydro-electric resources, which it would pay British capitalists to examine carefully.

Finance.—Bruce Peebles and Co., Ltd., of Edinburgh, have had another successful year's trading and the directors propose to pay dividends of 10 per cent. on the preference shares and 10 per cent. on the ordinary shares, plus a bonus of 5 per cent. This, after placing £15,000 to taxation reserve account and £5,000 to depreciation reserve account. Against this, the directors in their report state with rare caution that while "the results for the year may be regarded as satisfactory . . . it is hoped there should be some improvement in the current year" On this hopeful basis the shareholders will probably look forward to a 25 per cent. dividend in March, 1925.

Broadcasting in South Africa.—Interesting experiments in connection with wireless broadcasting in South Africa were carried out towards the end of December, when a series of five wireless concerts organised by the Railway and Harbour Service were transmitted from the Railway Headquarters Building in Johannesburg. The most successful reception in Cape Town was by Staff-Sgt. Bacon, who is the possessor of a Standard 2-Valve Gecophone Set. The music was most distinctly heard and recognised, and was given to the assembled company by means of a loud speaker. It would appear that the Gecophone Receiving Set will achieve an equally high reputation in the Union as it has in this country.

The Electro-Harmonic Society.—The last smoking concert of the season will be held in the Caxton Hall, Westminster, to-night (Friday), March 14, at 8 p.m. Chairman, G. L. Addenbrooke, Esq.

Batti Wallah's Society.—At the general meeting held on the 5th inst., Mr. A. J. Greenly was elected President for 1924, and Mr. F. Pooley Vice-President, with Mr. Mark Whitgift, 7, Coulter Road, Hammersmith, W.6, as Hon. Sec., and Mr. W. W. Browne, 12, Norfolk Street, W.C.2, as Asst. Hon. Sec.

Siemens Poster.—The Siemens and English Electric Lamp Co., Ltd., are issuing a very striking British Empire Exhibition poster, the lower part of which refers to their exhibit at the Palace of Engineering, and we hope it will be a means of attracting a very large number of our readers to their stall at this wonderful Empire Exhibition.

Diesel Engine Users' Assocn.—The next meeting is to be held on Friday, 28th inst., at the Engineers' Club, when a paper on "Heavy-Oil Engine Indicator Diagrams" is to be read by Mr. J. M. Ferguson. Non-members can make application for tickets of admission to Mr. Percy Still, Joint Hon. Sec. of the Association, at 19, Cadogan Gardens, S.W.3.

Meetings.—The Illuminating Engineering Society will meet at the Royal Society of Arts, John Street, Adelphi, London, at 8 p.m., on Friday, 21st inst., when discussions on "The Use of Light for Outdoor Advertisements" will be opened by Mr. G. P. Garbett, and on "The Use of Light in Shops, in Show-windows and for Display Purposes" by Miss M. Partridge, B.Sc.

The Inst. of Production Engineers.—It has been decided by the Council to award a Bronze Medal and the sum of £10 10s. to the member of any grade who, in the opinion of the Council, presents the best paper before the Institution each session. Similarly, a Bronze Medal and the sum of £5 5s. will be awarded each session to the member who, in the opinion of the Council, makes the best contribution to the discussions, either verbal or written, in connection with papers read before the Institution.

"D.P." Kathanode Batteries at Wembley.—As a means of transport a large fleet of "Railodok" Electric Passenger Cars will be used at the Exhibition. These will be the only means of transport within the grounds, in which there are about fifteen miles of roadway, and the entire fleet will be fitted with "D.P." Kathanode Electric Vehicle Batteries, as supplied to the principal electric vehicle users in the country. A special charging station is being built, and this will be a place of considerable interest to engineers visiting the Exhibition.

Mill Stores Formulæ.—All readers who are in charge of or work with electrically driven plant in which belting is used should make a point of writing forthwith to Ira Stephens, Ltd., at the Whitelands Tannery, Ashton-under-Lyne, and ask for a copy of their trade class or quality guide as just issued. It is not an advt. of their goods, but a carefully prepared dictionary of formulæ dealing with the various classes or qualities of mill stores—principally leather, which are in constant use by engineers. For instance, the various types of asbestos, belting (chrome, rawhide, balata, cotton, etc.), belt laces, rawhide mallets, friction wheels, etc., are all dealt with analytically, and their good and bad points discussed in a way certain to interest every engineer in charge of plant. Therefore, we advise them all to write for it at once.

Trade Notes.

Circular E.IV 9, dealing with overload time limit relays of the induction type, has been issued by the **Swedish General Electric, Ltd.**, of 5, Chancery Lane, London, W.C.2, and as the leaflet describes the mechanism and working of these relays very clearly, we can most cordially recommend it to our readers as being well worth careful perusal. It is not often that a pamphlet gives such full details as are furnished in this particular instance.

Leaflets 304/2-1 and 304/3-1, also from the **Metropolitan Vickers Electrical Co., Ltd.**, describe their earthing switches and earthing resistances for the protection of A.C. plant, and also give illustrations and details of earthing conections and earthing testing panels for use in power stations and substations. Both lists should, therefore, prove of direct value to central station engineers and installation contractors.

Owing to increased cost of raw materials, all prices of "**Hart**" portable batteries for wireless and for motor-car starter and lighting work have been advanced 5 per cent., commencing March 1, 1924.

Lamp Handbook 3D, which has just been issued by the **British Thomson-Houston Co., Ltd.**, is really a lamp bulb guide for car lighting, and is a comprehensive series of lists showing the types of Mazda lamp bulbs which can be used on the British, European and American cars, motor vans and commercial vehicles in daily use in the United Kingdom. The list is prepared for the trade only, and can be recommended to all factors, garage owners, and motor repair engineers who retail lamps of this description, to whom it will be sent on receipt of proper trade application.

The firm of **John M. Henderson and Co.**, of King's Works, Aberdeen, has been converted into a private joint stock company, which will continue to carry on the business as before. Included in their specialities are telphers, both automatic and hand driven, as well as electrically driven conveyors, ropeways, cranes and similar plant.

From the **Engineering and Lighting Equipment Co., Ltd.**, of Sphere Works, St. Albans, we have received list P.12, giving particulars of their new Monax Lighting Fittings. Monax is an entirely new departure in lighting glassware, the efficiency of which is claimed to be approximately 85 per cent., at the same time that it is entirely free from glare. The list should be of interest to all electrical contractors and illuminating engineers.

Messrs. Crewe, Allen and Co., electrical and mechanical engineers, of 23 and 25, Chapel Street, Cripplegate, London, E.C.2, announce that the partnership hitherto existing between Hy. T. Crewe and E. Allen has been dissolved by mutual consent, as from February 29, 1924. Mr. Hy. T. Crewe is withdrawing from the business at that date, and it will be carried on subsequently by Mr. E. Allen, as sole proprietor, under the same title, and he will take over all the liabilities and assets exclusively. Although ceasing from active participation in the business, Mr. Crewe will be able to act in an advisory or consulting capacity, should such services be required, and may be communicated with through the firm.

A monthly price list for March has just been issued by the **Siemens and English Electric Lamp Co., Ltd.**, of 38, Upper Thames Street, London, E.C.4, and will, as usual appeal to all electrical contractors and factors, to whom it will be sent on receipt of trade card.

A new catalogue of books on electrical engineering has just been issued by the **McGraw Hill Publishing Co., Ltd.**, of 6, Bouverie Street, London, E.C.4, and will willingly be sent to any reader of this paper, who wishes to receive a copy. It is a very comprehensive catalogue, and we can most certainly advise our readers to write for it. The books listed therein can always be obtained either direct from the McGraw Hill Co., or through Messrs. Rentell, Ltd., the proprietors of this paper.

A useful catalogue, No. B.B. 202, of dry cells and batteries, has been issued by the **Edison Swan Electric Co., Ltd.**, of 123, Queen Victoria Street, London, E.C.4, and should prove of direct value to all retailers and trade dealers in electrical goods, wireless supplies, etc., by whom it should be applied for without delay.

Two new lists issued by **Meldrums, Ltd.**, of Timperley, Manchester, deal respectively with the fuel combustion specialities and their acid-resisting pumps. The former, entitled F.D. Supplement, contains information and data of direct value to central station engineers, boiler attendants and all steam users, while the latter, C.25, is of interest to contractors and engineers who may have to instal electrically driven pumps in chemical factories, breweries, vinegar works, etc.

Messrs. Electrical Productions, Excelsior Works, Ellis Street, Birmingham, have secured the whole of the stock, plant, and designs relating to the "Ventex" Fuse System, and they have arranged for this to be produced on a much larger scale than hitherto.

A new 12-page list, No. 820A, fully describing the Siemens Thermo-Electric Pyrometers has been issued by **Siemens Bros. and Co., Ltd.**, of Woolwich. These pyrometers are specially suitable for temperatures of from 500 deg. to 1,400 deg. C., and are divided into two classes, namely, those fitted with :—(*a*) Rare metal thermo-couples, *e.g.*, platinum and its alloys, and (*b*) base metal thermo-couples, *e.g.*, iron, constantan, etc. The former class are the more durable, and will withstand a higher temperature, but are, of course, more expensive; while the latter will give perfectly satisfactory service when used for temperatures up to 1,000 deg. C., and will give a considerably greater thermo-electric force than those under class A. Various types of temperature indicators are also described in the list, as well as temperature recorders, connecting leads, switches and accessories.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

MARCH 21, 1924.

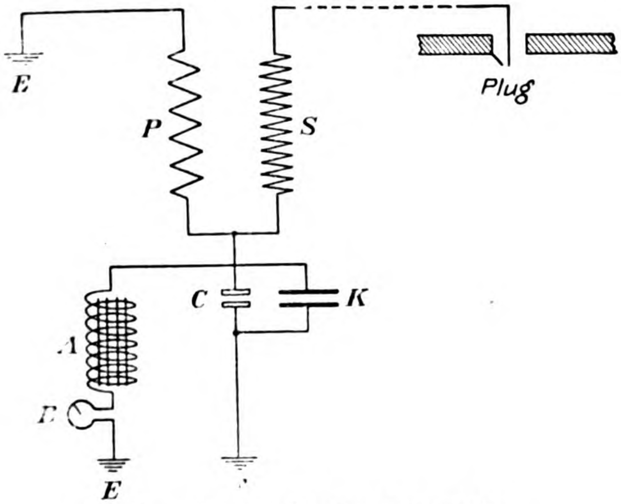
CONTENTS.

PAGE
Experiments with a Magneto Lighting Set 145
Armature and Coil Winding from a Conversion Point of View 147
The "Gecophone" Two-Stage Low-Frequency Amplifier .. 148
Artificial Sunlight at Olympia 148
Current Topics 151
Ideal Home Exhibition 152
C.T.S. 153
Questions and Answers by Practical Men 153
Telephony (Solutions) 155
Problems in Telephony, Solved and Unsolved 155
Lighting a Furniture Store Window 156
Water-Tube Boilers 157
Reviews of Books 157
Various Items 158

EXPERIMENTS WITH A MAGNETO LIGHTING SET.*

By T. W. Hugh-Jones (*Faradian*).

There are one or two devices on the market which utilise part of the current generated in the magneto to light a rear light or an emergency front light. It occurred to me that it would be both interesting and useful to endeavour to construct such a set for myself. My machine is a two-stroke motor-cycle, and the magneto consequently runs at engine speed; thus the frequency of the light would be double that obtained from a similar four-stroke machine. The connections for the set are as in the diagram, where—



P—primary circuit of magneto.
S—secondary circuit of magneto.
C—contact-breaker points.
K—condenser.
E—earth.
A—choking coil.
B—bulb.

The tapping leading to the choking coil is taken from the centre stud of the magneto by a hard-steel spring, exactly as for a magneto cut-out switch. A cover with spring contact and terminal can probably be obtained from the makers of the magneto, or one can be made fairly simply.

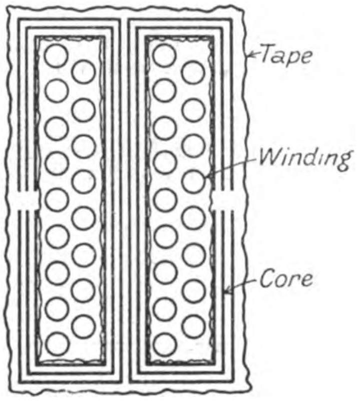
The principle is roughly as follows:—The primary circuit in an ordinary magneto, since it is revolving in the magnetic field of the permanent magnets, has induced in it an electro-motive force of varying amplitude and direction. During the period in which the platinum contacts are closed, a current will flow through the primary, and it is so arranged that, when the current is at its maximum value, the platinum points are opened and the current abruptly ceases. It is this sudden cessation of the primary current which causes e.m.f. of extremely high voltage (anything up to 15,000 or 20) to be induced in the secondary, and causes a spark at the plug points. Now, if a choking coil and a bulb be placed, as shown, across the contact-breaker points, when the points open, the current, instead of falling away to nothing, flows through the bulb, and only falls to a value determined by the impedence of the circuit. Thus a light is only obtained while the platinum points are open. Also, since the secondary voltage depends on the change in value of the primary current, the strength of the spark is reduced. Hence, apart from any question of overloading the magneto, there is a very definite maximum value of the current which can be taken from the primary without stopping the engine firing. The object of the choking coil, of course, is to limit the value of the current at high engine speeds, since the voltage generated by the magneto is roughly proportional to the speed. Also the reactance of the choking coil is proportional to the frequency, that is, to the speed, and so the current is fairly constant. It is true that the wave form is nothing like a sine curve, but it is pulsating, and in the absence of other data the ordinary formula must be used. With suitable values of choke and bulb the light can be kept fairly constant at ordinary speeds, though it falls away rapidly at dead slow, and also flickers very noticeably.

Having outlined the action of the circuit, it will be seen that there are no data for any calculations of values, and the whole thing must be experimented with until suitable values of choke and bulb resistance are found. I will describe my own experience, as it leads to some interesting points.

The choking-coil core was made of 12 strips of stalloy about 6 in. by $\frac{1}{4}$ in. by 0.02 in., $1\frac{1}{2}$ in. of each end being bent at right angles and the centre parts of the strips being taped securely together. The winding is then put on, and consisted in my case of two layers of fairly thick enamelled wire, about 100 turns, I should judge. This was again taped over, and then the ends of the strips bent over so that the finished coil had the shape shown in section in the diagram. A small air gap should be left between the ends of the strips, or excessive loss will occur in the iron. This choking coil was placed in series with a 3.5 volt. 3 ampere bulb (an ordinary good flashlight bulb), and gave quite a reasonably good light without interfering with the functioning of the magneto. This set ran for some weeks on journeys up to eight or nine miles, and then I decided to tackle a thirty-mile ride with it in the company of a friend with a powerful headlight, since the light obtained from my magneto is not sufficient for comfortable night riding. In the afternoon my plug needed cleaning, and the points were reset rather wider apart. We had covered about eight miles of the return journey in the dark when the bulb blew. I inserted a spare, which lasted another twelve miles, and then that burnt out. Two policemen, who unfortunately stopped me just after this, supplied me with two more bulbs, one of which burnt out immediately, the other lasting about eight miles. It was obvious that something was radically wrong with the set, but the insulation of the choking coil was in good order, and the only thing that was different was the plug setting. To test the effect of this, I wired up an ordinary 0-6 volt. pocket voltmeter for battery testing across the platinum points in place of the lighting set. On starting the engine there was a very unsteady reading on the voltmeter. This, of course, gave no indication of the true value of the e.m.f. generated in the primary. On shorting the plug with a screwdriver the voltmeter reading fell away immediately to nothing before the engine had stopped; and on pulling the lead off the plug there was a distinct kick in the voltmeter before dying down. This seemed to point to the fact that the spark gap did make a difference, so I closed it up to about its original value, put in a new bulb, and tried it. It ran well for several days, and showed no signs of burning out. I noticed later, when suffering from a slight attack of misfiring, that when a bad miss occurred the light became momentarily much brighter.

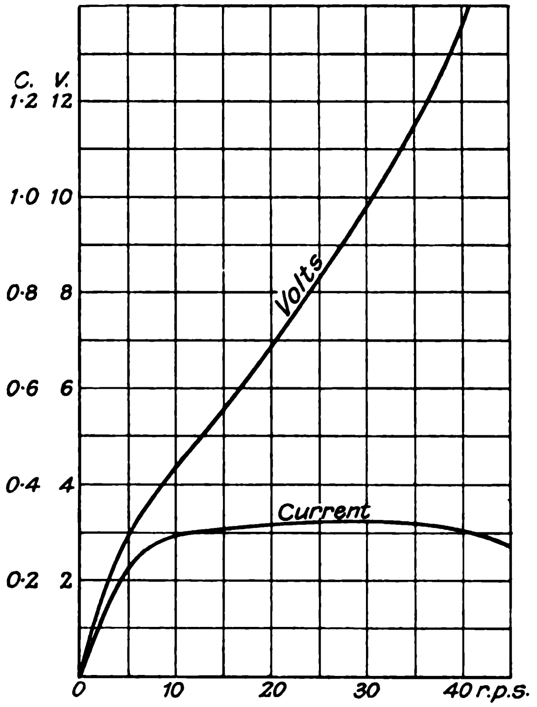
---

* From the *Faraday House Journal*.



My explanation of this effect is this: The voltage across the plug points is entirely controlled by the voltage at which the air will break down and allow a spark to cross; that is, the voltage at the plug is directly proportional to the gap length, so long as a spark does actually occur. Consequently opening the plug points increases the voltage which the secondary must generate in order to make a spark occur. Or, to put it in another way, less load is being taken from the magneto, since the resistance across the secondary terminals is greater. Now, neglecting the voltage generated in the secondary by its rotation in the magnetic field, which is fixed for any one speed, the ratio between the primary and secondary voltages depends only upon the number of turns in the primary and secondary, and is therefore also fixed. Hence, if the secondary voltage increases, the primary also increases. The machine has very bad voltage regulation, and any change in load has a very appreciable effect on the secondary, and hence the primary, voltage.

I did not notice any particular variation in the performance of the cycle on either plug setting, which seems, within limits, not important in the functioning of the engine.



GRAPH 1.—CHOKE 0.15 *h*.

Having come to this conclusion, I decided to fit a larger choke to prevent future accidents. After some very interesting, but very rough, calculations, I found that with an inductance of 0.15 henries the current at varying speeds should be as shown by the graph. Accordingly, a second choke was constructed with three layers instead of two, and a slightly larger core. On trying this on the machine the results were quite satisfactory, the light remaining fairly constant at ordinary speeds. Also the light was better at slow speeds, though it still died away rapidly at dead slow.

I can highly recommend this as a very interesting experiment for anyone requiring a "bobby-dodger" light for short journeys, or in towns, or for a rear light. My experiment has brought home to me the great complexity of the magneto, which I had not previously appreciated. To instance a few of the questions which arise: What harm does the system do to the magneto itself, beyond slightly increasing the heating of the armature? Could it tend to demagnetise the magneto? Would it be better, from the magneto's point of view, to have poor current regulation, taking a fairly small current at a high power factor, or to have good current regulation taking a larger current at a low power factor for the same light? And there are hosts of other points.

Tenders Accepted.—The G.E. Co. have obtained contracts and orders for the supply of lamps to:—Southern Railway: Six months' supply of Osram lamps, vacuum and gasfilled, also carbon filament lamps; Brighton: Large supplies of Osram lamps, vacuum and gasfilled for lighting the sea-front and general street lighting; Admiralty: Large supplies of special metal filament mast-head signalling lamps, also two further contracts for standard Osram lamps and special types; Liverpool: Order for Osram traction lamps; British Empire Exhibition: Order for a large quantity of Osram projector type lamps for floodlighting of buildings.

ARMATURE AND COIL WINDING FROM A CONVERSION POINT OF VIEW.

By C. SYLVESTER, A.M.I.E.E., A.M.I.Mech.E.

(*Concluded from page* 95.)

We have assumed the armature to be wave wound. There will, therefore, be two circuits through it in parallel, as illustrated in Fig. 8. It therefore follows that, since the voltage to be impressed upon it is half its normal value, the speed will be slightly less than half that obtained when running under its full voltage.

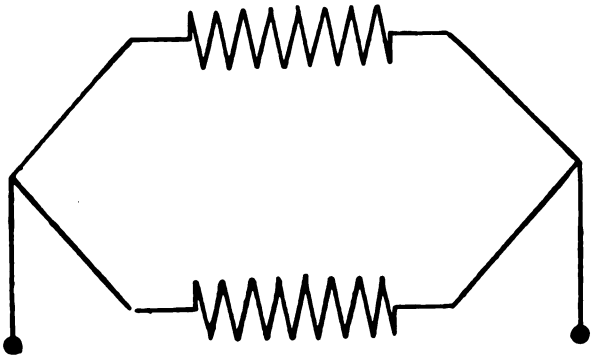


FIG. 8.

Now the rewinding of an armature is an expensive job and should never be carried out if it can be avoided. In the case under consideration, however, it will be beneficial if the chief points which lead up to the 200-volt requirements are discussed.

The chief factor which decides the rewinding of an armature is the cross-sectional area of the conductors with which the armature is wound. In this case it is evident that, since the voltage is halved, if the motor is to develop the same power on the lower voltage there must be twice the normal amount of current passing through the armature. As the armature is already wave wound, it can be seen that under these conditions it is not possible for more than the normal amount of current to pass through the windings, since the field strength of the motor is of the same value as when on 400 volts, and because the back electromotive force at 200 volts is almost half that generated on 400 volts. Again, if it were possible to allow more current through the winding, the conductor would not carry it without excessive overheating, and this would be detrimental to the insulation.

From the above it would appear that the armature must be rewound unless we consider another type of winding with the same conductors, that is, merely changing over the connections without disturbing the armature coils. We will, therefore, assume that we alter the connections from a wave winding to a lap winding.

We now have four paths for current through the armature, as illustrated in Fig. 9. Comparing the resistances of the respective wave and lap windings, it will be found that the resistance of the latter is one-fourth that of the former. It does not follow that, when the motor is in operation, four times the normal current will flow through the windings. It must be remembered that, although the resistance is one-fourth of the original resistance, the voltage is halved, and this will pass the normal amount of current through each armature path. This, therefore, since the armature is rotating in a field of the same strength as that produced on 400 volts, enables the motor to develop the same horse-power at the original speed.

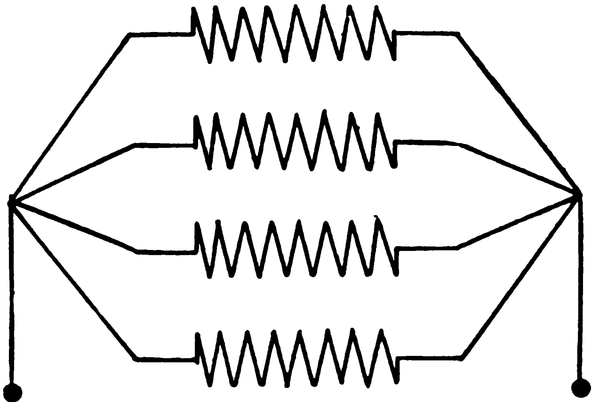


FIG. 9.

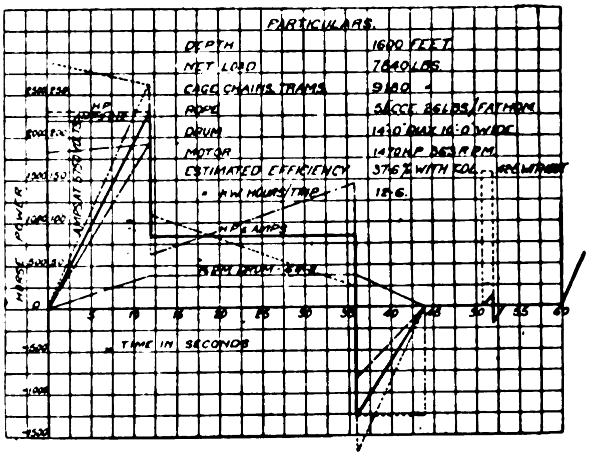
---

* "Armature Winding," by Mr. C. Sylvester, is a clearly written practical work for the armature winder. It may be had for 8s., post free, from ELECTRICITY Office.

ELECTRIC WINDERS.

We are in receipt of a new catalogue from the Metropolitan-Vickers Electrical Company, Trafford Park, Manchester, on the above subject. The term "catalogue" does not adequately describe the volume, since it may be considered as a source of information concerning the technical details of winding and winding equipment.

The general notes on electric winding deal with the necessity for winding equipment which must be efficient if the best of our mineral resources are to be obtained. This section also deals with the elementary principles of electric winding, and gradually leads up to types of drives, etc.



TYPICAL H.P. TIME DIAGRAM FOR BALANCED WINDER WITH PLAIN CYLINDRICAL DRUM AND TAIL ROPE.

The control of electric winders and their mechanical arrangement are given a large amount of consideration, and the subject of ropes for these machines is clearly dealt with. We reproduce a H.P. time diagram from the book for a balanced winder with plain cylindrical drum and tail rope. This diagram is self-explanatory and contains a mine of information.

THE "GECOPHONE" TWO-STAGE LOW-FREQUENCY AMPLIFIER.

This amplifier, which is illustrated herewith, was designed as a companion instrument to the Gecophone two-valve receiving sets, the same standard of workmanship and performance being embodied in it. It has been designed as the result of considerable research, in order to eliminate distortion and to give the best possible result with the loud-speaker. For this purpose special transformers are used, and exceptionally clear and efficient reception is obtained.

As will be seen from the diagram, the amplifier is mounted in a flat box, the valves being completely enclosed and thus protected from damage and dust. The whole unit forms a base upon which the standard two-valve Gecophone set can be placed, all interconnection being made at the back by means of plugs and sockets, so that even a novice can connect it up correctly.

The cabinet is in polished mahogany with hinged lid, the control switches being mounted on the front of the instrument. These controls consist of :—

(1) A specially designed switch having four positions. The first position disconnects all batteries, leaving all adjustments on the set unaltered.

In the second position the telephones or loud-speaker are connected direct to the receiving set without the low-frequency amplifier, and the third and fourth positions switch in successively the two stages of low-frequency amplification.

(2) The filament resistances are controlled by two knobs on the front of the box.

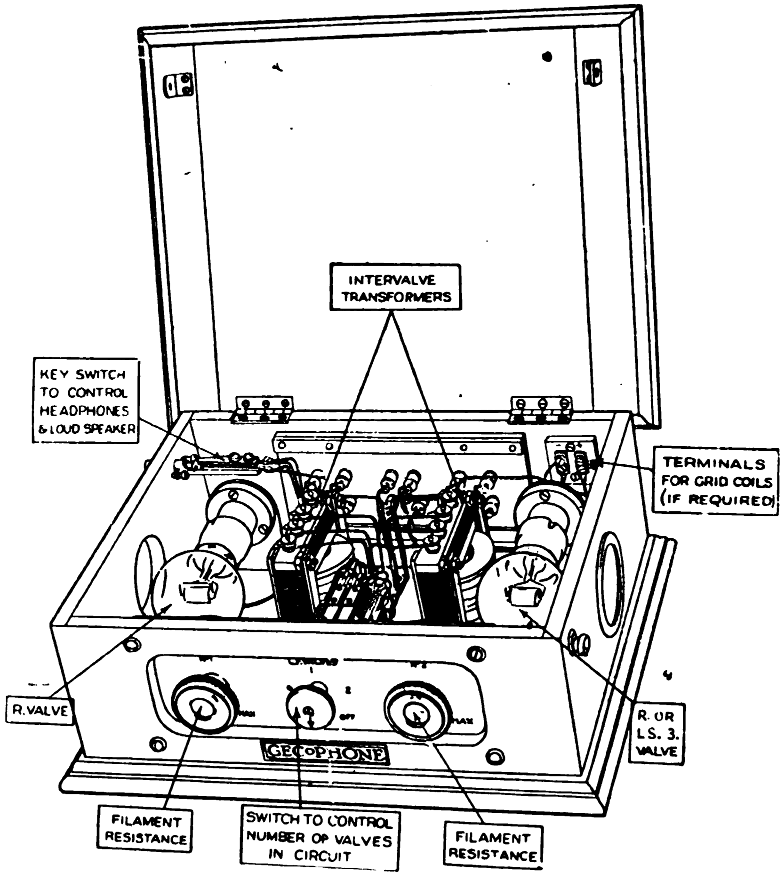
At the back of the case is a three-position push-in switch, which in one position connects the headphones only, the second position the headphones and the loud-speaker, or two pairs of headphones, while the third position switches in the loud-speaker only. This device enables tuning to be effected on the headphones and the loud-speaker switched on when tuning is completed.

Two terminals inside the case are provided for the attachment of grid cells, if it be necessary to increase the negative grid bias of the low-frequency valves. Normally a 1½ volt negative grid bias is provided by a single dry cell.

The handy instruction booklet, BC.3076, issued by the G.E.C. with these amplifiers, is a model of clarity, good clear line diagrams showing exactly how the amplifier should be connected and operated, and a useful table being supplied giving suggestions for types of valves to be used, with suitable values for high-tension and grid voltages.

The postal address of the **Relay Automatic Telephone Co., Ltd.**, has, we are informed, been changed to Relay House, Streatham Hill, London, S.W.2. Will readers please note this.

B.E.X.—The sole concession for supplying all lubricants for machinery in the Palace of Engineering has been granted to **Messrs. Sterns, Ltd.**, who will have a central lubrication depot from which supplies may be obtained as required.


INTERVALVE TRANSFORMERS
KEY SWITCH TO CONTROL HEADPHONES & LOUD SPEAKER
TERMINALS FOR GRID COILS (IF REQUIRED)
R. VALVE
R. OR LS. 3. VALVE
GECOPHONE
FILAMENT RESISTANCE
SWITCH TO CONTROL NUMBER OF VALVES IN CIRCUIT
FILAMENT RESISTANCE

ARTIFICIAL SUNLIGHT AT OLYMPIA.

Those who have visited the Royal Gardens in the Annexe at the Ideal Home Exhibition must have been astonished and delighted at the natural appearance and careful arrangement of the lighting.

For this the organisers of the Exhibition consulted The British Thomson-Houston Co. with a view to obtaining, by artificial means, an illumination which should in colour and quality approximate closely to sunlight. In accordance with the advice given, they installed a number of powerful Mazda Daylight Lamps, the bulbs being made of a special blue glass which, by filtering the light and absorbing the excess red and yellow rays, produces an illumination of daylight tone. The lamps themselves are not visible, being completely enclosed in Trojan fittings.

The installation consists of one hundred and twenty such fittings, each containing a three-hundred watt Daylight Lamp. These are suspended below a light coloured muslin ceiling.

There is no doubt at all about the success of this large-scale experiment in producing artificial daylight. The general atmosphere in the gardens is exactly what one would expect in any open-air garden on a sunny afternoon, while the flowers and foliage have an absolutely natural appearance.

Mazda Daylight Lamps can also be used very successfully in artists' studios, printing works, for colour matching in shops, and in many industrial processes where the accurate perception of colour values is important.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and Abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Tuesday morning, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription : 13s. a year, 6s. 6d. half year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No.: 2460 Gerrard.

Current Topics.

Hypocrites?

I am beginning to wonder whether as a nation we are not just a trifle hypocritical in our attitude towards housing and domestic utility problems. Are we not tackling those problems from the wrong end, viewing them in distorted perspective, as it were? For example, in the face of an acute housing shortage, and with thousands of our population to all intents and purposes homeless, and likely to remain so for an indefinite term of years, judging by the present rate of building, we concentrate on an Ideal Home Exhibition. Truly an entrancing picture of the "might have been," but scarcely calculated to satisfy the longings of those unfortunate families who have been on the waiting list for unbuilt houses for the past four or five years. We all want ideal homes, but the trouble is we can't get them under the present conditions, so why tantalise us with practical demonstrations of what could be done if we had only had the money, and the land, and the labour, to attain these ideals.

Again, in the face of electricity tariffs reaching as high a figure in some localities as a shilling a unit, we preach the gospel of domestic electric service, when the very essence of universal electrical service in the home is cheap electrical energy. You cannot logically argue that electricity at a shilling, eightpence, or even sixpence a unit is cheap, nor is it convincing to the average householder to be informed that the "advantages" of electric lighting, cooking, ironing, vacuum cleaners, and the like amply compensate for the additional outlay incidental to wiring his house, getting current laid on, etc. If he is an average man, he will consider your proposition in the light of £ s. d., and take the advantage for granted. How can you justify electrical service in the home at anything like sixpence per unit?

In view of the enormous field for future development of electricity supply for domestic purposes, it seems to me that some of the many thousands of pounds at present spent on domestic service propaganda could be more profitably invested in securing an all-round reduction in the cost of wiring unwired houses, and secondly in a campaign having for its main object the reduction of costs, both of generation and distribution. Existing conditions are so anomalous; for example, we are told that the use of electricity in rural Wales for lighting and power purposes is rapidly increasing. In several upland villages electric light may be found in every tiny cottage, and in some remote farmhouses even the pig-sty is so lit! In London, on the other hand, the average price of electrical energy is so high that questions have been raised in Parliament, and the Electricity Commissioners are about to issue a new draft Order for reorganising the supply.

Something will have to be done to overcome the drawback of heavy capital expenditure on wiring houses, or we shall make little or no progress with householders living in unwired premises. A neighbour of mine has just bought his house, an old one, of the average six-roomed variety, and is having electric light installed. It is costing him nearly thirty pounds, of which over four are accounted for by the Corporation service main and fixing of the meter. How many working or middle-class householders could afford the initial outlay of thirty pounds, just to have electric light in the house, in view of the present cost of living, and the average wage standard? Isn't it obvious that we of the industry can only rope in this vast population of potential consumers by some universal scheme of free or assisted wiring, coupled with the provision of a reasonably low-priced unit for all purposes? Under existing conditions and with all our pretty pictures of electrical domesticity, our daily Press propaganda, our municipal showrooms, our electrical exhibitions and the like, we are only touching the fringe as it were

Some of the more enterprising supply undertakings are making a brave effort, but they are too few and far between to accomplish radical reform. We were promised cheap electricity after the war, just as we were promised "houses fit for heroes," and nearly six years after the Armistice we are still waiting and preaching the gospel of the All-Electric Home. True, we must not belittle the efforts of those who have worked so strenuously in their own localities to secure cheap electrical service. Hackney, for example, is deserving of praise, and even Poplar, despite its unenviable reputation in other respects. Hammersmith Corporation is also displaying the true spirit of enterprise, and its Electricity Committee are to inquire into the cost of the free installation of electric light in every dwelling-house in the borough not already so equipped. That's the spirit; if only it could be inculcated into every supply authority throughout the country. Free or assisted wiring and the cheap unit. Accomplish this first and the All-Electric Home will inevitably follow in the natural course of things.

Farmers' Telephones.

Once again there is a revival of the earlier demands by the National Farmers' Union for improved telephone facilities in rural districts and agricultural communities. Indispensable as the telephone is to the populous business communities where distances are small and the traffic such as to justify large and intensively-operated telephone exchanges, now in process of conversion to automatic working, it would prove invaluable to the farmer, living often some miles distant from his nearest markets or shopping centres. The telephone is, in fact, more useful to the country dweller than to the townsman as a means of communication over considerable distances. The bar to greater development of rural telephones has hitherto been the difficulty of operating and maintaining small scattered telephone exchanges in remote country districts where the traffic is not heavy enough to justify a staff of only partially occupied switchboard operators on constant service.

With the advent of Strowger Automatic Telephony that difficulty no longer exists, for the Strowger Community or Village Automatic Telephone Exchange requires no operators, no permanent maintenance staff, can be housed in any out-of-the-way weather-proof building, and will give constant day and night service with the rest of the country. The Strowger Automatic Telephone System has, in fact, long since solved the rural telephone problem in America, and is already on trial by the Post Office authorities over here. These isolated and self-contained exchanges are maintained and supervised from the nearest town, require very little attention and afford the subscriber all the acknowledged advantages of automatic service, including cheap party line rates.

The C.T.S. Competition.

Now that the end of March is drawing near I am wondering what kind of papers will be sent in by our Colonial readers, many of whom ought to be able to contribute some interesting items of practical information. This also affords me an excuse for directing attention to the paper sent in by Mr. Burdick, of Tynemouth, and to whom the C.T.S. Co. have, I understand, also sent a guinea prize. Those who have followed the humour of the C.T.S. advertising schemes will, I am sure, smile broadly at the way in which Mr. Burdick writes.

The A.E.U.

In the issue of February 22 last I wrote about my interest in the membership of this great trade union, and how much I hoped that the steady fall in numbers would come to an end. It is, therefore, very gratifying indeed to note in the March issue of the A.E. monthly journal that at the end of February the drop in membership had been turned into an increase on the figures of the previous month. This looks like turning the corner, and although the increase is only 114, yet it is in the right direction, and I hope that month by month the returns will show a yet more rosy aspect. In this connection it is something to bear in mind that a former secretary of the A.S.E., namely, Mr. Robert Young, has been elected as chairman of Committees and Deputy Speaker of the House of Commons. A splendid testimonial to his abilities and impartiality.

Some Straight Talk about Engineers.

I have always felt an interest in the Junior Institution of Engineers—it seems to me to be *alive.* Would that other institutions were the same! The president, Mr. C. C. Garrard, Ph.D., recently gave an address in which, dealing with the psychology of engineering, he said some very useful and *real* things. Reading his remarks, I felt as I felt once when listening to Mr. J. S. Highfield, when he was president of the I.E.E.: Why, here is a man I'd like to work for. Well, now, what had the J.I.E. president specially good to say? For one thing, I liked his summing up of an engineer's characteristics: (*a*) Capacity for assuming responsibility; (*b*) precision in his work; (*c*) optimism. As to (*a*), he gave a good example of what he was driving at. He said that the real officer of a ship takes responsibility, and is willing to risk his reputation. *By so doing he shows he has one to risk.*

When talking of optimism, and the necessity for it, the speaker was particularly apt. He urged and urged again, how pessimism is hurtful, how the *fear of failure brings it.* If you haven't got enthusiasm and hope (many of us haven't naturally), they have simply got to be cultivated, and, if you will, regarded as part of the training. The best thing is to wipe failure out of your mind. Of course, everybody has set-backs in the rough and tumble of life. My own experience is that you never really reach your goal; but when you've pushed on a bit, and taken a breather and a look behind, the fact that you *have* got on even by a little span is cheering enough. There's a lot, too, in keeping moving, even when you're not forging ahead.

Many readers will feel restless at all this. They will think that I am talking "through my hat" and doing a bit of cheap sermonising. This is not so, I assure them. I am a practical man, and have lived in industrial life all my working days. I do really wish that I had always known the magic recipe that is concealed in the last paragraph. And I wish I could go on, for more space than I am allowed, to quote and to chat upon Mr. Garrard's remarks about the great influence engineers can exert in the world's affairs, and particularly upon international trade and co-operation. I believe that the time is not far distant when the engineer, high or low, will come into his own, and be recognised as the skilled brain-and-hand worker that he is. I even believe that the shipyard engineers, perhaps more hard-hit than any other class by the great depression, will yet come to the top.

ELEKTRON.

IDEAL HOME EXHIBITION.

Electricity plays a very great part in this exhibition, and, one might claim, goes a long way to make the homes suggested in reality "ideal." Certain it is that by the many and varied uses in which electricity is applied for lighting, heating, cooking, and in the adaptation of the many labour-saving appliances for the lessening of the household work and the supercession of manual labour, the home life can be made much more attractive, healthy and pleasant than in the days—not so very long ago—when no such facilities existed.

Amongst the electrical firms showing specialities and fittings, many of which are to be seen *in situ* and in operation in the full-size specimen houses and bungalows forming a distinct and unique feature of the exhibition, are Messrs. Hewson and Lown, of Oxford Street, London; Messrs. Christy Brothers and Co., of Chelmsford, who show a complete lighting plant, with engine, dynamo and batteries compactly installed; Messrs. Falk Stadelman and Co.; Messrs. Billing and Co.; Messrs. British Thomson-Houston Co.; Messrs. Girdlestone and Co., showing generating plant with engines of the Petter and also Armstrong Whitworth types; the Delco Light Co., showing their special compact combination suitable for lighting country houses and bungalows; whilst the exhibitors of electrical heating and cooking apparatus, suction cleaners, washing machines, irons, bells and telephones and details of a like character, and which contribute so largely to modern convenience and comforts in the home life, are too numerous to mention. There are also several firms showing wireless apparatus, and a practical demonstration of this very modern and recently developed science is given daily in a large hall, and lectures explanatory of the many interesting features and methods of application are given by qualified members of the B.B.C. staff and others. We can most certainly congratulate the *Daily Mail* on the undoubted success of the exhibition as a whole.

C.T.S.

By S. G. Burdick, Tynemouth.

Description.

C.T.S. is a piece of rubber with a length of wire pushed through it. The rubber is known as the dia-something, and the wire as wire.

Advantages.

C.T.S. can be run on the surface or concealed. The advantage of the latter method is that the cable is not usually seen. C.T.S. is useful in such situations as tanneries, soap-works, guano-works, etc. Its great advantage in this connection to foremen and the like is that its use renders the supervision of the wiremen unnecessary.

C.T.S., being unaffected by water, oil, grease or acids, makes ideal tyres for perambulators. The wire is specially placed in the rubber for this purpose: If the dia-thingummy be bared back, the two bare ends of wire can be twisted together to make the tyre grip.

C.T.S. is obviously the stuff Mr. Heath Robinson uses for the full-size models from which he makes his drawings; no other cable could take the strain.

C.T.S. telegraphic code word: "Cats." Chosen because both are vermin-proof, smooth to touch, but hard in the heart.

C.T.S. is perfectly waterproof. If you pull the wire out and send the dielectric—got it!—back to the St. Helens people they will be pleased to stretch same laterally and return to you as a perfectly good hose-pipe. The wire should not be thrown away, but retained for binding the pipe to the bathroom tap.

C.T.S. component parts have other uses too numerous to mention, but I cannot think of any further use for the product in its entirety.

Disadvantages.

C.T.S., owing to its bulk, does not answer as well as V.I.R. for bootlaces, braces, etc.

The continued use of C.T.S. makes the wireman incapable of exerting his mentality, owing to that talent becoming atrophied.

The writer has been using C.T.S. for a considerable time, so cannot think of any more "Disadvantages." (See preceding sentence.)

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient intsrest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

Commencing with Question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

Question No. 177.

I am in charge of a large D.C. motor plant, and I wish to design a starter that will start, in case of emergency, any motor from 5 h.p. to 75 h.p. Can any reader give me some helpful suggestions which can be embodied in the design?—"Tester."

Question No. 178.

I am in charge of a 4-pole, ½ h.p. 85 period A.C. motor of the repulsion type. I cannot prevent the excessive sparking which occurs at all loads. Can any reader give me some helpful suggestions?—J. E. Wilkins.

[*Replies to Questions Nos.* 177 *and* 178 *must be received not later than March* 29, 1924.]

Answers to Questions.

Question No. 173.

I am employed on railway signalling, and I do not understand the construction and principles of operation of the following:—

(1) Track relays, galvanometer type.
(2) Track relays, vane type.
(3) Detection relays, polarised vane type.
(4) Purpose of shading bands on latter.

I would appreciate the details of operation, etc. The tracks are single-phase, 25 to 33½ cycles.—"Jack Allen."

Replies to Question No. 173.

The first prize (10s.) has been awarded to "Train-Shunt" for the following reply:—

The relays mentioned belong to two distinct classes. The galvanometer type consists of two coils, one placed at an angle to the other.

The action is as follows:—

One coil, the field or local coil, which is immovable, consists of many turns of fine wire of about 900 ohms resistance. It is fixed so that the armature or track coil, consisting of a few turns of thick wire of negligible resistance, can be pivoted centrally inside it (see Fig. 1).

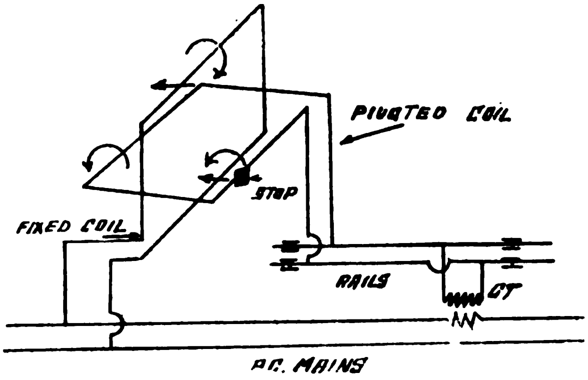


FIG. 1.

The armature coil is placed at an angle to the field coil and moves between stops. Attached to the armature coil are light rods moving contact making and breaking mechanisms.

The field coil is connected permanently to the A.C power supply.

The armature coil is connected in an appropriate manner to the rails in the track circuit.

When no current reaches the armature coil, i.e., when it is shunted by a train, the armature rests on a stop.

When a current of the requisite strength flows in the armature coil it is converted into an electro-magnet of suitable strength.

The current flowing in the field coil also converts it into an electro-magnet with its poles at an angle to the poles of the armature coil.

The sketch shows the polarity at one instant as the alternating current flows round them.

It will be noticed that the N. pole of the armature coil is in the S. pole of the field coil, and is therefore attracted by it, and the armature coil would be lifted off the stop.

If the action is worked out for other current directions the same attraction (and repulsion) between the armature and field coils will be discovered.

To get the best results the currents on both coils should be in phase or 180 deg. out of phase, but in this case the connections of the armature coil must be reversed. If they are 90 deg. out of phase no movement will take place.

It is possible to use these features to prevent the wrong relay operating in an adjacent track circuit should an insulated rail joint fail. The armature coil connections to the rails are reversed, so that it would tend to press against the stop instead of lifting should the wrong current reach it. It can therefore be used as a polarised relay.

Approximate values for the power required to operate galvanometer-type relays are 100 volts, 0.6 amps A.C. in field or local coil and 1.25 volts 3 amps. in armature or track coil, both at 60 frequency.

These relays are not suitable for A.C. traction railways. The vane type relay works as follows, and there are three types of them, the single-element, two-element, and single-element frequency relay, all working on the same principle.

The fundamental action is based on the field created by eddy currents induced in a sheet of metal, the vane.

In the single-element relay (see Fig. 2) which is the simplest form, there is a laminated iron magnet core with the poles placed close together. On the end of each pole and enclosing half of the iron end are two copper bands, the shading bands referred to in the question.

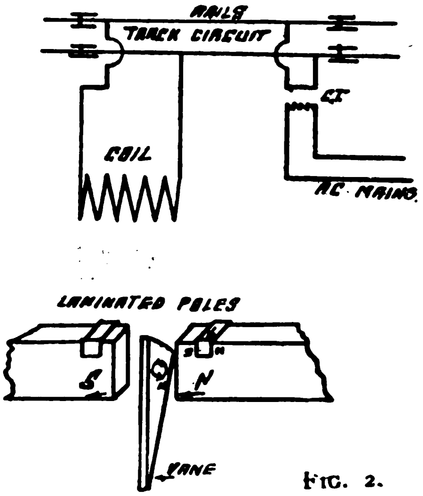


FIG. 2.

Moving on pivots between the poles is a vane made of aluminium for lightness and because it is non-magnetic. To it are connected light rods for operating contact making and breaking mechanisms.

On the magnet core is wound a coil of wire of appropriate size.

When about 5 amps. at 2.5 volts 33.3 frequency flows in the coil, conditions are set up as shown by the sketch, which illustrates those at one instant only. It will be noticed that the N. pole is on the right. The growing field causes a current to be induced in the vane which creates another magnetic field tending to oppose the growing field. Repulsion, therefore, exists between this part of the disc and the pole.

Now, the top part of the iron pole is encircled by a copper band. At this instant a current is induced in it and creates a field tending to weaken the growing main field. A state of attraction therefore exists between the enclosed iron and the vane, and so the vane is lifted and climbs upwards until it either presses against a stop or reaches a state of balance of the magnetic forces against its weight.

The frequency of the alternations is so great that the vane cannot fall down and rise up again between each reversal.

With the two-element vane relay there are two separate magnet coils excited from different sources, and it is necessary for them to receive current of the correct value frequency and phase relationship before the vane can lift. Multiple poles are provided.

The single-element vane frequency relay has a triple-headed pole piece between which the vane moves.

The middle pole is enclosed by a copper band, the lower pole is unshaded, and the upper pole head has copper laminations inserted between the iron laminations.

The copper laminations are so designed that at chosen frequencies the current induced in them is of such a value that the resultant magnetic field from the pole piece will not lift the vane.

While this is a simple way of explaining the action of this relay, the actual working is more complex.

This feature prevents the relay responding to any alternating current other than the correct one, and in this respect it is polarised.

It will be understood from the above descriptions that the purpose of the shading bands is to create a distortion of the magnetic field coming from the magnet pole and so cause a lifting force to be developed between the pole and the vane.—" TRAIN-SHUNT."

December 30, 1923.

No second award is made.

TELEPHONY.[*]

Being solutions to questions selected from the Telephony, Grade I., Examination, held by the City and Guilds of London Institute on May 3, 1923.

Q.—What is meant by (i.) " polarisation " and (ii.) " local action " ? How are they eliminated or minimised in the batteries commonly used at subscribers' premises ?

A (i.).—When copper and zinc plates are placed in a vessel containing dilute acid, and they are joined by a wire, the oxygen of the acid attacks the zinc, and hydrogen is liberated which collects in a thin layer on the copper plate. This action may be shown by the following equation :—

$$Zn + H_2SO_4 + H_2SO_4 + \ldots. = ZnSO_4 + H_2SO_4 + \ldots H_2$$

Hydrogen is electropositive to zinc, and it therefore tends to set up a current opposed in direction to the true zinc to copper current. Further, the layer of hydrogen bubbles increases the resistance of the cell. These effects are termed *polarisation*, and polarisation can be overcome by employing in a cell a compound which will oxydise the hydrogen. Different compounds are employed in different cells for this purpose, e.g., in the Daniell and Bichromate cells copper sulphate and chromic acid respectively are the depolarising agents.

The type of cell commonly used at subscribers' premises in this country is a special form of Leclanché. In this cell the excitant is sal ammoniac (NH_4Cl), and the depolariser is powdered manganese dioxide (Mn_2O_3). The hydrogen set free by the sal ammoniac when the cell is worked combines with the oxygen of the manganese, forming water as shown by the two following equations :—

$$Zn + 2NH_4Cl = ZnCl_2 + 2NH_3 + H_2$$

and

$$H_2 + 2MnO_2 = Mn_2O_3 + H_2O.$$

(ii.).—Ordinary commercial zinc contains many impurities, such as iron, lead, tin, arsenic, etc. These, together with the zinc in contact with the acid, form minute cells and wastefully consume the zinc. This action is termed *local action*.

Local action is overcome in the Leclanché cell by the process termed *amalgamation*, which consists in coating the zinc with mercury, when it behaves as if chemically pure.

(*To be continued.*)

CANADIAN ENTERPRISE.

Most of our readers are perfectly well aware that Canada is making giant strides in regard to the development of electrical enterprises which add enormously to the facilities with which yet other commercial undertakings can be opened up as sound business propositions. Electricity, however, is not the only branch of the engineering profession in which Canada is doing big things. The port of St. John, New Brunswick, can now boast of being the proud owner of the largest dry dock in the world, and full particulars of it, as well as of other important local undertakings, were given in a record special issue of the *St. John Telegraph Journal* on Monday, October 29 last. Space does not permit us to give details of the developments which are taking place in this very go-ahead city, but so far as the dock itself is concerned its extreme length is 1,225 ft., with a top width of 133 ft. and 42 ft. depth of sill at high water ordinary spring tide. The generator capacity is 2,250 k.v.a., and the dock equipment includes ten 15-ton capacity electric capstans, a 15-ton travelling crane, a self-contained floodlighting system, an electrically-operated pump capable of emptying the dry dock in four hours, as well as complete repair shops and similar equipment. Altogether, it is a very fine piece of work, and one which reflects great credit on the engineers who were responsible for its design and construction. Let us hope that it will not be long before it is pressed to its utmost capacity owing to the growth of the local export and import trade.

PROBLEMS IN TELEPHONY, SOLVED AND UNSOLVED.[*]

BY PROFESSOR J. A. FLEMING, M.A., D.Sc., F.R.S.

(*Continued from page 143.*)

VIII.—THE PROBLEM OF MULTIPLE TELEPHONY.

(15) Years ago the problem of the use of a single telegraph wire to carry simultaneously several telegraph messages was solved by the invention of duplex, quadruplex, and, later on, by systems of multiplex telegraphy, especially by such ingenious machine telegraphs as those of Baudot and Murray. The analogous advances in telephony have been slower in arriving, but the magic thermionic valve has given us not only the solution of the telephone repeater problem, but also the valuable carrier-wave multiple telephony. The adoption of phantom working was one of the first steps in effecting an economy of conductors [†] When we have a pair of mutually non-inductive double-wire circuits, whether twisted aerial or quad cable, we have a pair of circuits, called the side or physical circuits, through which two independent telephone conversations can be conducted. But we can employ also one pair taken together as the lead and the other pair taken together as the return of a third or phantom circuit. In some cases we can use all four wires as a lead and an earth return to make a fourth circuit.

---

[*] Books recommended are *Questions and Solutions in Telegraphy and Telephony, Grade I.*, by Few (Rentell, 5s 10d. post free), and *Practical Telephone Handbook*, by Poole (Rentell, 15s. 6d. post free).

[*] Lecture delivered before the Institution of Electrical Engineers, to whom we are indebted for the illustrations.

[†] The earliest patent application in Great Britain for that mode of connection called phantom working was made by Mr. F. Jacob in British Patent Specification No. 231, of 1882.

Not only can we load with Pupin coils the two side circuits, but extremely ingenious modes of coil winding with four wires have been devised which enable us to load the phantom circuit independently of the two side circuits. Phantom-circuit working and loading is now very extensively carried out in the telephone circuits of the United Kingdom and in the United States.

A further mode of effecting economy in conductors is the utilisation of existing telegraph wire circuits for simultaneous telephony.

It would occupy too much space to describe in barest outline a fraction of the work done in this department since the method first introduced in 1882 by F. Van Rysselberghe gave an impetus to further invention, which was continued by Mr. C. L. Langdon-Davies in his ingenious Phonopore and finally reached a stage represented by the Fullerphone of Major Fuller.* The most recent practice in this development, particularly the use of circuits called *composited* circuits, was described in a paper last year by Mr. J. G. Hill, entitled "Phantom Telephone Circuits and Combined Telegraph and Telephone Circuits Worked at Audio Frequencies."† Hence it will not be necessary to make further reference to this part of the subject.

(16) On the other hand, new and important methods of multiple telephonic working have been lately introduced in the form called "carrier-wave" telephony, which depend on the use and properties of the thermionic valve. A few explanations of this method may therefore be of interest. It will be necessary to assume that the methods of connection and the process by which the three-electrode valve is used to produce high-frequency oscillations are familar. Also a knowledge of the broad general principles of apparatus used for radio-telephony must be taken for granted. In radio-telephony we set up high-frequency oscillations in an aerial wave by means of a valve generator, and we control the amplitude of these oscillations by appliances which include a speaking microphone, so that the amplitude of the high-frequency oscillations is varied in accordance with the wave-form of the speech sounds. We therefore produce two simultaneous sets of electric vibrations, one a high-frequency sine-form oscillation, and superimposed on this a low- or audio-frequency speech current (see Fig. 12). These complex aerial currents radiate electromagnetic waves of an identical character. At the receiving end the waves are absorbed by the receiving aerial and rectified by the receiving valve, and then passed through a receiving telephone which reproduces the speech sounds made to the transmitter microphone.

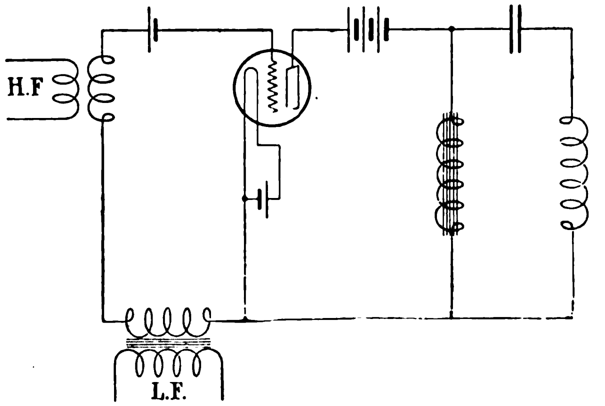


FIG. 12.—DIAGRAM SHOWING THE MODE OF SUPERIMPOSING LOW FREQUENCY (L.F.) AND HIGH FREQUENCY (H.F.) VOLTAGE VARIATIONS ON THE GRID OF A THERMIONIC VALVE.

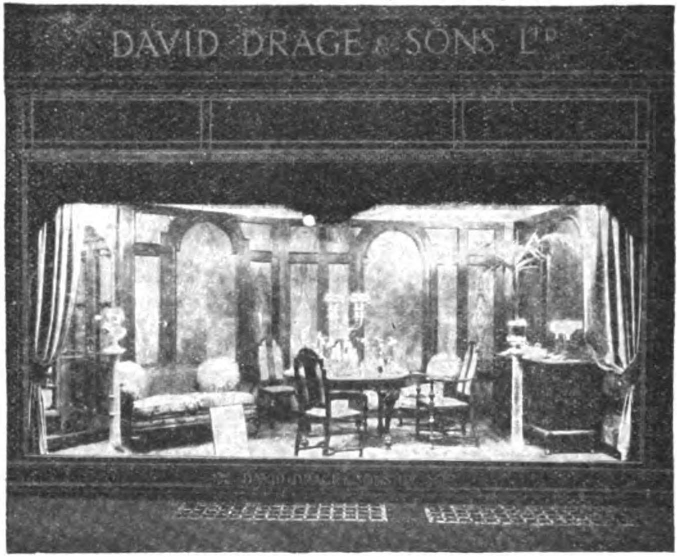
In the above-described arrangement the high-frequency electric waves are used to carry to a distance variations of their own amplitude, and are, therefore, called *carrier* waves.

If we imagine the sending and receiving aerials to be connected by a wire, these waves would not be able to disperse in all directions, but would be guided along the wire. The arrangement is then called guided-wave or carrier-wave telephony, as contrasted with radio telephony.

(*To be continued.*)

LIGHTING A FURNITURE STORE WINDOW.

The annexed illustration has been made from a photograph of one of the windows of Messrs. David Drage and Sons, Ltd., which has recently been rebuilt and equipped with up-to-date window lighting equipment on the Gecoray system, presumably with a view to inducing Mr. and Mrs. Everyman to purchase yet more furniture from this very live firm of house furnishers.



The usual system of a row of reflectors on the ceiling close to the glass has been adopted in this instance, the Gecoray mirror glass reflectors being placed approximately 12 in. apart. Some forty reflectors are used in all, and these are wired on two separate circuits in order that alternate units may be used, as well as either full power or half power, and alternatively colour-changing effects can be obtained by having all the lamps on one circuit fitted with Gecoray colour screens, the remainder being left clear.

To supplement the lighting from these reflectors, five G.E.C. window floodlights and five spotlights have been installed, and these are adjustable so that their rays can be trained on any specific object in the window to which special attention is required to be directed. They are left illuminated until late at night, when the lights are extinguished by means of a G.E.C. time switch.

---

* See *Journal I.E.E.*, 1919, Supplement to vol. 57, p. 20.

† See *Journal I.E.E.*, 1922, vol. 60, p. 675.

Altogether the installation reflects great credit on the Illuminating Engineering Department of the G.E. Co., by whom it was designed.

WATER-TUBE BOILERS.

At an ordinary meeting of the Junior Inst. of Engineers, on Friday, March 14, Mr. L. M. Jockel, M.I.E.S., A.M.I.Mech.E., read a paper on this subject, in the course of which he summarised the recent developments in water-tube boilers, and indicated the present features and utility of that type. In dealing with the principal stresses in boiler drums and water-tubes, he said that the apparent factor of safety was enormous, but there were compound stresses present which could not be calculated, and for which some allowance must be made. One particular trouble was that of grooving, which occurred at the flanges of the dished ends of boiler drums.

It was stated that larger combustion chambers were now being provided, especially in cases where pulverised fuel was used, or where the fuel being burnt was fairly high in volatile matter. In recent designs about six cubic feet of combustion chamber were allowed per square foot of grate area. In the Stirling boilers at Gennevilliers the combustion chambers had a height of nearly thirty feet.

Particulars of a test with an air preheater were given, and the lecturer thought that developments in the application of preheated air would assist in obtaining efficient combustion with the minimum amount of furnace brickwork.

The types of mechanical stokers were briefly described, and reference was made to the multiple retort type which is at work at Gennevilliers. The boilers at this station were said to have a maximum rating of about 180,000 lb. of steam per hour.

Discussing future developments, Mr. Jockel said he thought that pressures would increase about the present figure of 500 lb. per sq. in., but that temperatures would not probably exceed 800 deg. F. The Benson boiler recently constructed at Rugby would work at a pressure of 3,200 lb. per sq. in., and an experimental boiler said to be under construction for Chicago was designed for a pressure of 1,200 lb. per sq. in., with primary and secondary superheaters and an economiser. The steam and water drum was to be 4 ft. dimeter, and have a wall thickness of 4 in.

Riley Stokers.—Riley stokers are being adopted for the six large new boilers for the extension of the Buenos Aires Central Station; also for important Central stations in France, Italy, Sicily, Holland, Switzerland, Japan and Australia.

Finance.—The balance-sheet of the South London E.S. Corpn., Ltd., for 1923 is another of the satisfactory documents which are now being issued in all parts of the kingdom. The directors recommend a final dividend of 8 per cent. on the ordinary shares, making 12 per cent. per annum together with a bonus of 3 per cent. This after making ample allowances for depreciation and general reserves.——The report of the directors of the Chelsea E.S. Co., Ltd., for 1923 is yet another in the same category. It is proposed to pay a final dividend on the ordinary shares at the rate of 15 per cent. per annum, making 12 per cent. for the year, after making ample allowance for reserves, renewals, depreciations and contingencies.

Reviews of Books, &c.

[Books noticed in this column will be sent from ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

THE MOTOR ELECTRICAL MANUAL. Second edition. 185 pp., illus. (Temple Press, 2s. 6d. net.)—Since the first edition of this handbook was issued the intervening period has been one of important developments in the application of electricity to the motor-car. Lighting and starting systems, of which there are many individual types, are now standard car equipment, and there have been many improvements in ignition and road warning appliances, and various auxiliary, if minor, applications of electricity have also been developed, so that, more than ever before, the motor owner or user needs to have a working knowledge of these various electrical applications to ensure efficiency in running and minimise the cost of upkeep of his car by being able to maintain the equipment in good working order. This new edition has been largely re-written, re-illustrated and enlarged, and its scope as a practical handbook of instruction extended to bring it up to date and include the latest improvements. We think that in this edition the motorist will find all the electrical information that he requires and that can be of practical value to him. There are over one hundred new illustrations.

THE BOOK OF THE FORD ELECTRICAL EQUIPMENT. Second edition. Cr. 8vo, 169 pp., illus. (Temple Press, 2s. 6d. net.)—Since "The Book of the Ford Electrical Equipment" was first introduced, it has been obvious, from the favourable reception accorded it, that it has met a want long felt by Ford car owners. In this popular handbook, dealing entirely with the electrical equipment, the Ford owner has a valuable source of practical information on this special subject. The author, Mr. R. T. Nicholson, treats the subject in his well-known lucid, non-technical style. The "why and wherefore" of the various parts of the electrical equipment is explained, namely, the lighting, starting, ignition, and road warning appliances. The book is profusely illustrated, and this edition has been fully revised and considerable new text and a number of new illustrations included. The Ford owner who desires to maintain the electrical equipment of the car in the most efficient condition will find this handbook indispensable.

BRITISH STANDARD SPECIFICATION FOR ELECTRIC LIGHTING AND STARTER CABLES FOR AUTOMOBILES. (No. 5002-1924. 1s. 2d. post free.)—This specification gives the dimensions of lighting and starter cables for system pressures of 6 and 12 volts nominal, but does not deal with the composition, quality or durability of the insulating material used as the dielectric.

The specification is divided into seven sections, four of these dealing with various types of lighting cables, and the remaining three being concerned with starter cables, the dimensions being given both in inches and millimetres throughout. Three types of covering are included for both classes of cable, namely (*a*) braided and compounded, (*b*) metallic armoured, and (*c*) cab tyre sheathing.

Various Items.

Personal.—Mr. C. Sylvester, A.M.I.E.E., A.M.I.Mech.E., has resigned his position on the staff of the British Thomson-Houston Co., Ltd., lighting service department, and will terminate his engagement with them on the 22nd inst Mr. Sylvester has been handling the publicity section of this department since its inauguration.

Social.—The last Siemens staff social of the season was held at 38/39, Upper Thames Street, on Friday evening, 14th inst. A very enjoyable concert commenced the proceedings, and in addition to a number of variety turns, two sketches were successfully produced. A dance followed the concert, and the evening was a great success.

Tenders Accepted.—The Corporations of Liverpool and Brighton have accepted the tenders of Siemens and English Electric Lamp Co., Ltd., for the supply of large quantities of Siemens helical traction lamps and Siemens vacuum type lamps respectively.——The War Office have accepted the tender of the Edison Swan Electric Co., Ltd., for the supply of 400 steel boxes.

Forthcoming Books.—Messrs. Ernest Benn, Ltd., are publishing immediately the first volume of Messrs. C. V. Drysdale and A. C. Jolley's comprehensive work on electrical measuring instruments. This volume deals with commercial and indicating instruments. The price will be 55s. net. Also Dr. Lander's long-expected work on "The Low Temperature Carbonisation of Coal" will be published by them in a few days' time.

Smoking Concert.—The last smoking concert of the Electro-Harmonic Society for the present season was held at the Caxton Hall on the 14th inst., when Mr. G. L. Addenbrooke presided over a representative muster of gentlemen connected with the electrical profession in all its branches. The programme provided was really first-class, and all the items were much appreciated, encores being the invariable rule.

Siam.—A report on the commercial situation in Siam has just been issued by the D.O.T., and may be obtained from H.M. Stationery Office or ELECTRICITY office, price 1s. 7d. post free. In the section dealing with the electrical goods and apparatus it shows that there has been a reduction in the imports, which is attributed to the general trade depression. The bulk of the apparatus is still supplied by the U.K., although Germany is creeping up rapidly.

Readers, Remember!—The British Electrical and Allied Manufacturers' Association direct attention to the fact that, in furtherance of technical education, they grant annually, to properly qualified candidates of British birth engaged in engineering works, ten scholarships, each of the value of £100, in addition to the payment of college fees. The last date for receipt of applications is June 1. Form of application and full particulars may be obtained by writing to the Secretary, the B.E.A.M.A., 36, Kingsway, London, W.C.2.

Electricity—A Social and Domestic Power.—Mr. C. H. Wordingham, C.B.E., gave a very interesting lecture at Queen's Gate Gardens on Monday, the 10th inst., to a large audience consisting of members of the British Women's Patriotic League, dealing with electricity as a social and domestic power. The considerable interest evoked was apparent from the large number of questions after the lecture, information being sought on such subjects as the utilisation of water-power, the disposal of house refuse, variation in charges, uniformity of voltage, and, of course, *the origin of electricity*. Lady Cowan was in the chair, and amongst those present were: Lady Walston, Lady Harcourt Smith, Baroness de Teissier, and Lady Ollivant.

Belgium.—The D.O.T. report on Belgium to December, 1923, has just been published by H.M. Stationery Office, and may be obtained from them or from ELECTRICITY office, price 3s. 3d. post free. It is quite a bulky work of 112 pages, various sections of which will be of interest to electrical engineers For instance, on page 53 reference is made to the steady growth in the use of electric presses in the brickfields of Belgium. Owing to the shortage of labour these machines are being used to a greater extent, as with only three workmen they will produce 800 to 1,000 bricks per hour. Page 73 has an article on the steady increase in the development of electric light and power throughout the country, and shows how the leading companies have all had to increase their capital owing to the remarkable growth in the demand for current. It also gives particulars of the further schemes which are now under consideration. On page 78 statistics are given in regard to the growth of the telegraph system in Belgium, from 318,000 kilometres of line on December 31, 1913, to 687,000 kilometres on October 31, 1923. Altogether the book is remarkably interesting and instructive from a commercial point of view.

Quotations Wanted.—The founder of the new observatory on Mont Salève, Haute Savoie, France, is desirous of receiving quotations for various apparatus from United Kingdom manufacturers.——The N.S.W. Government, Chief Mechanical Engineers' Branch, at Sydney, invite tenders for the manufacture, supply and erection (on rails provided by the Chief Commissioner) of three cranes of the electric overhead travelling bridge type at the Chullora electric car repair shops near Sydney.——The Egyptian Ministry of the Interior invite tenders for the supply, delivery and erection of electric motors and accessories, cables, and switchboards for water installation at Mehalla el Kobra.——The Public Works Department, Wellington, N.Z., invite tenders for the supply and delivery of turbines and generators. Specifications, etc., at the D.O.T. (Room 52), 35, Old Queen Street, S.W.1.

South Africa.—The January issue of the *Transactions of the South African Inst. E.E.* contains a report of the annual general meeting held on January 17, together with a reprint of the valedictory address of the retiring president, Mr. R. F. Botting, in the course of which he dealt at some length with the advantages of cheap electric power in order to keep a white population "on the land," and then went on to enumerate certain subjects on which he would like to see papers read in the near future. His most interesting address was illustrated with some good photos of types of battery locomotives, coal-cutting machines, etc. There is also the reply by Mr. H. A. Johnson to the discussion on his paper on the Strowger Automatic Telephone System, and a paper on the Technique of Radio Broadcasting by Mr. F. H. Amis, B.Sc., of the International Western Electric Co., Inc. Altogether a very readable issue.

Meetings.—A meeting of the Birmingham and District Electric Club will be held at the Grand Hotel, Colmore Row, on Friday, 21st inst., at 7 p.m., when a lecture will be given on "A.C. Commutator Electric Motors" by Mr. H. Dreghorn, B.Sc. (of the B.T.-H. Co., Rugby).——The Junior Inst. of Engineers will meet on Friday, 21st inst. Lecturette: "Sulphuric Acid Plants, New and Old," by P. Parrish (member). Slides. Also on Friday, 28th inst. Lecturette: "Wood-wool; its Manufacture and Application," by A. J. Simpson. (Exhibits). And on Friday April 4. Lecturette: "Mineral Oils, with special reference to lubricating and insulating oils," by A. J. Sear, A.R.C.S All at 39, Victoria Street, at 7.30 p.m.——The I.E.E will meet in the Lecture Theatre of the Institution on Thursday 27th inst., at 6 p.m. Paper: "The Future of Main Line Electrification on British Railways," by Lt.-Col. H. E. O'Brien, D.S.O. (member).

GRINDERS
DRILLS
"DEPENDABLE"
& POLISHING LATHES
MARRYAT & PLACE, ENGINEERS.
28 HATTON GARDEN, E.C.2.

Sample Pair Sent on Approval for 8/6
Made of Pure Para Rubber soft and durable and unaffected by climatic condition.
DAVID MOSELEY & SONS
Limited.
ARDWICK MANCHESTER.
MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

MARCH 28, 1924.

CONTENTS. PAGE

E.H.T. Switchgear 159
Illuminating Engineering: its Application and Value to the Electrical Industry 160
"Wittonite" Cable Cleats 160
A New Fittings Showroom for Sheffield 161
Telephony (Solutions) 161
Questions and Answers by Practical Men 162
Current Topics 165
B.E.A.M.A. Annual Meeting and Luncheon 166
A Remarkable Lighting Installation 167
Problems in Telephony, Solved and Unsolved 167
C.T.S. in the Tropics 169
The Future of Main-Line Electrification on British Railways 169
Reviews of Books 170
The Relay Automatic Telephone at Wembley 172

E.H.T. SWITCHGEAR.*

By T. J. Barfield, Student, I.E.E.

Introductory.

The growth in the capacity of generating stations and interlinked systems within recent years and the consequent increase in the forces which are encountered under short-circuit conditions on large systems, has emphasised the need for the robust construction of every item connected with electric power supply. Particularly is this true of E.H.T. switchgear, which may be regarded as the nerve-centre of the system, responsible for the control and protection of the plant, and for the localisation of faults and interruptions of supply. In consequence, the design of E.H.T. switchgear has been considerably modified and improved within recent years.

The author describes the points in the design of switchgear apparatus which are affected by modern conditions of service, compares the relative merits of different types of switchboards, drawing attention, in particular, to advantages in features of design which are realised more by supply engineers than by manufacturers, and points out features essential in switchgear for use on systems of large short-circuit capacity.

The most important item in an E.H.T. switchgear equipment is probably the oil circuit-breaker, since this may have to break, not only the full load of the circuit controlled, but the full short-circuit capacity of the system, amounting in some cases to many hundred thousand kilovolt-amperes. The chief factors in the design of such a breaker are as follows:—

(1) Sufficient head of oil above point of break, since the quenching effect of the oil depends mainly on the hydrostatic pressure.

(2) Adequate air space above the oil to provide satisfactory cushioning.

(3) Design of contact fingers, so that the passage of current shall increase the pressure at the point of contact, thus obviating arcing.

(4) Speed of break, which must be high to avoid an arc being struck at the crest of the voltage-wave before the breaker has properly opened.

The various features of modern designs incorporating the above essential details are considered.

Current transformers with multiturn primaries are a source of weakness on large systems, since the relatively fine primary winding may be fused by the passage of even a momentary short-circuit current, and the advantage of the bus-bar type having a bar primary is dealt with. The question of insulation is rendered more severe by the possibility of surges on feeders entering the windings as the first reactance in their path.

Potential transformers have always been a source of weakness, due to the fine wire employed in their windings, and the limited space available for insulation. The need for limiting resistances in series with the primary fuses, and the advantage of locating the secondary fuses as near as possible to the low-tension terminals, is dealt with.

Among various types of E.H.T. switchboards, the sheet-steel truck type and non-interlocked sheet-steel cubicles are very suitable for use in average size sub-stations and small power stations. They have the advantages of low first cost and ease of extension, but leave much to be desired as regards localisation of a fault on any one item of the equipment. For power station work, moulded stone cubicles, with phase separation and proper precautions against the entry of rats, give satisfactory service. The ironclad compound-filled type of switchgear has recently come into extensive use, and this design is certainly attractive from the point of view of robustness, total enclosure of all live gear, safety in operation and cleaning, and saving in space, but it has the disadvantage of high first cost.

A complete description of modern protective gear is not within the scope of the paper, but mention is made of the Merz-Price, split conductor, and Ferranti-Hawkins systems as typical of modern practice. These systems are discriminative in their action, enabling a fault to be confined to the feeder actually affected, whereas overload protection often results in a whole system being shut down as a result of a failure on one section. The need is now realised for continuity of supply, the effect of even temporary interruptions being very damaging to a supply company, both through loss of revenue and prestige.

It is now general on very large systems to sectionalise the generating and distributing plant, for the purpose of assisting further in the maintenance of supply, relieving the system of shock due to a fault on one section, and enabling less robust switchgear to be used in sub-stations. These sections are coupled through reactances which limit the amount of power which may be interchanged between sections. By this means a short circuit on one feeder or machine only seriously disturbs the section to which it is directly connected, an advantage on systems supplying synchronous machinery liable to drop out of step on sudden changes in the frequency of supply. Very large sums are expended in sub-station and consumers' switchgear, and the limitation of short-circuit power by the installation of reactances enables considerable saving to be made in this part of the equipment.

---

* Abstract of paper read before the I.E.E., London Students' Section, February 15, 1924.

Throughout the paper stress has been laid on the enormous forces which are encountered under short-circuit conditions on large systems. It is difficult to form a mental conception of these forces, but by visualising, say, ten times the energy needed to drive the underground trains of London concentrated in one oil circuit-breaker, the need will be realised for extreme care in the design and selection of E.H.T. switchgear for use under modern conditions of large stations and interlinked systems.

ILLUMINATING ENGINEERING: ITS APPLICATION AND VALUE TO THE ELECTRICAL INDUSTRY.

The informal talk on the above subject, given by Mr. L. Gaster before the Institution on March 17, led to an interesting discussion.

In his address Mr. Gaster showed that all sections of the electrical industry stand to benefit by a movement for better lighting. Apart from its obvious value to makers of lamps and lighting appliances, such a movement means greater consumption of electricity, a demand for new wiring and switchgear in improved installations, and ultimately additional plant to meet the increasing load.

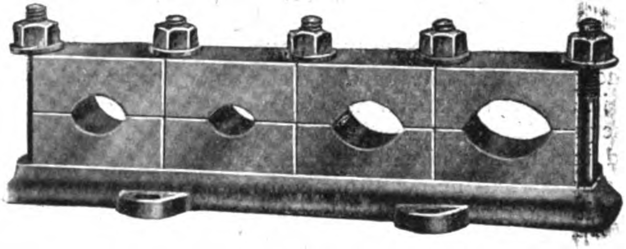
But at the same time illumination is not a matter of purely technical interest. The consumer must be consulted. This was illustrated by the work of joint committees dealing with school and library lighting, on which educational experts and librarians took part. In tracing the origin of the illuminating engineering movement, Mr. Gaster pointed out how greatly the standard of illumination has risen during recent years; even during the war the average candle-power of electric lamps supplied to the public was nearly doubled. But in going to the consumer and urging him to increase his illumination one must be sure of one's ground and must be furnished with authoritative data such as the user will accept. Recommendations for a legal minimum in the interests of safety had been made by the Home Office committee. But in regard to working illumination discretion must be exercised. No doubt better lighting results in greater efficiency. But one can hardly compel people to be efficient by legislation!

Reference was made to the prospects of new developments in lamps, which should not be judged entirely from the standpoint of efficiency in candles per watt. An instance was furnished by the mercury vapour lamp with quartz envelope; its applications for ultra-violet ray treatment of disease, sterilisation, etc., were not foreseen by the inventor; yet its value in this respect outweighed in importance the gain in luminous efficiency. Many other problems, such as the development of artificial daylight, the lighting of shops, factories, mines, railways, etc., were touched upon, and were subsequently illustrated in a series of slides shown by Mr. J. S. Dow.

The discussion after the interval was opened by Mr. J. Eck, and a number of those present took part, general agreement being expressed with the views of the lecturer. In replying Mr. Gaster specially emphasised the fact that recommendations on lighting affecting a large section of the public should not be imposed by makers of lamps and lighting appliances only; but, in order to meet with acceptance, must be based on investigations in which both lighting and other experts and users of light took part. In illustration of this he quoted the views expressed by Prof. E. L. Nichols, in the *Transactions* of the American Illuminating Engineering Society, explaining the scheme for dealing with this problem on broad lines by joint action under the National Committee for Research.

"WITTONITE" CABLE CLEATS.

A new cable rack system employing cable cleats has recently been produced by The General Electric Co., Ltd., in order to take advantage of the valuable properties possessed by "Wittonite," a special composition manufactured by the company at their moulded insulation works, at Witton, near Birmingham, and which has been extensively used by them in the last few years for insulating bushes, terminal blocks and the bodies of small electric accessories where high-grade insulating properties are required. Its application therefore to cable racks is only a natural development.



The conventional cable rack is recognised as the ideal method for surface fixing of mains and other heavy cables. The porcelain cleats commonly used, however, are expensive and liable to crack or chip. On the other hand, it is claimed that "Wittonite" cable cleats are considerably lower in price than porcelain cleats, and are entirely non-hygroscopic throughout their whole substance, so that they do not lose their qualities in this direction if chipped. They are also far less liable to crack, and the material is softer, so that the danger of a cracked cleat cutting into the insulation of the cable is reduced to a minimum. Further, they are stated to be extremely accurate as to dimensions, and being initially black in colour they do not show dust so badly as the porcelain type.

"Wittonite" has a high mechanical and dielectric strength, and, as previously mentioned, is non-hygroscopic, but it does not rely in any way on an external coating for these qualities. The material has a softening point of 180 degrees Fahrenheit; that is to say, it is quite hard up to that temperature. Whilst it is not claimed to be fireproof, it does not readily sustain combustion, and is, therefore, very suitable material for the purpose indicated.

Lectures.—Mr. Frank Hope-Jones, M.I.E.E., vice-chairman of the British Horological Institute, is to lecture on "The Free Pendulum" at the Royal Society of Arts on Wednesday evening, April 9, at 8 p.m., when the chair will be taken by Professor C. Vernon Boys, F.R.S. Mr. Hope-Jones has also been invited to broadcast on the subject of "Time and Time Signals" from 2LO on Saturday, April 12.

A NEW FITTINGS SHOWROOM FOR SHEFFIELD.

The British Thomson-Houston Co. have recently opened a new showroom adjoining their main offices in Campo Lane. It is situated on the ground floor, and has been tastefully and artistically decorated, the walls being panelled with white mouldings and the background being in French grey, with mahogany furniture and showcases in the Queen Anne style. An interesting feature therein is a model show window, in which can be demonstrated the famous B.T.-H. X-ray system of lighting. Coloured lighting and "spot-lighting" effects can also be obtained. Of this we give an illustration herewith.

Demonstration Shop Window in B.T.-H. Sheffield Showroom.
(The bare lamps visible in the picture represent the worst form of bad lighting. When photographed, the window was lighted by concealed X-ray reflector units.

The display of fittings in the showroom is very comprehensive, and includes all types of units for domestic, commercial and industrial lighting. There is also a section devoted to the display of heating and cooking appliances.

It is hoped that this new B.T.-H. showroom will prove of considerable value to local electrical contractors and suppliers who may wish to bring, or send, their customers for the purpose of selecting fittings and other equipment. This, of course, is the proper function of a manufacturer's showroom, and the British Thomson-Houston Co. are using their best endeavours to see that all their showrooms are used for this purpose only.

"**Twentieth Century Advertising**."—The March issue of this very go-ahead journal opens with an interesting article on the subject of "Will Advertising Bring World Peace?" by J. Murray Allison. It treats more particularly on the fine achievement of Mr. Ed. Bok, whose autobiography has just been published, and who as the founder of the American peace award is a keen enthusiast in trying to drive the war fiend out of the world. Other articles review current Press advertising, the possibilities of British trade in the United States, and all sorts of subjects which should appeal to men who wish to push the trade of the country by means of advertising generally. One of the most interesting is the article on "Four Ways of Advertising Engineering Products," by Eric M. Simons.

TELEPHONY.*

Being solutions to questions selected from the Telephony, Grade I., Examination, held by the City and Guilds of London Institute on May 3, 1923.

(*Continued from page* 155.)

Q.—What is a metallic circuit? Are metallic circuits much used in telephony? If they have any advantages, what are they?

A.—A metallic circuit is one in which the whole path of the current, going and returning, consists of a metallic conductor. Metallic circuits are employed in this country in telephony almost to the exclusion of single-wire circuits, the latter being used for short lines in districts free from other electric plant.

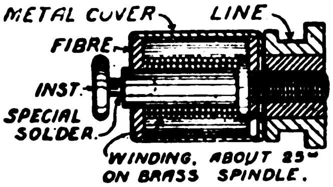
The advantages metallic circuits possess over single wire circuits are:—

(i.) They are not so liable to be affected by inductive disturbances due to other telephone circuits or telegraph circuits in the vicinity, or by power or lighting circuits in the neighbourhood.

(ii.) They are not affected by "earth" currents, which sometimes render the working of single-wire circuits impracticable. Metallic circuits are not affected to the same extent as are single-wire circuits from the effects of thunderstorms.

Q.—Sketch and describe the construction of a heat coil, and indicate what happens when it operates.

A.—The "A" type of heat coil employed by the British Post Office is shown in the figure.



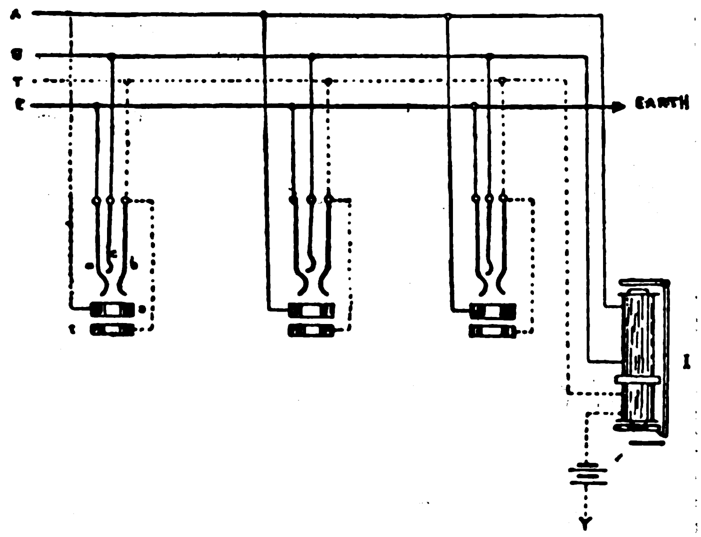
It consists of a small brass bobbin, having fibre cheeks, and wound with double-silk covered German silver wire to a resistance of 4.5 to 5.5 ohms. One end of the coil is soldered to the bobbin, and the other end is carried to an insulated metal washer which is screwed on an extension of the bobbin. A hole is drilled into the left end of the bobbin into which a pin with a large head is soldered with a special solder of low fusing point. The head of the pin is held by a spring which is in metallic connection with the instruments. When a current of 500 milliamperes passes for as long as 60 seconds the heat generated melts the solder and the pin is pulled out by the action of the spring and the circuit is disconnected.

The type of heat coil just described is generally employed at subscribers' premises and sometimes in magneto exchanges. A somewhat similar type of heat coil "B" is fitted on the main distribution frames in all new common battery exchanges. It differs from the "A" type in that the coil itself moves along the pin when the solder melts and makes earth by making contact with an earthing spring. The resistance of the coil is from 3.5 to 4.1 ohms. The coil operates when a current of 500 milliamperes flows for as long as 210 seconds.

---

* Books recommended are *Questions and Solutions in Telegraphy and Telephony, Grade I.*, by Few (Rentell, 5s 10d. post free) and *Practical Telephone Handbook*, by Poole (Rentell, 15s. 6d. post free).

Q.—Show with the aid of diagrams how an operator in a multiple magneto exchange determines whether the line of a wanted subscriber is free or busy.



A.—The figure shows the arrangement of a parallel multiple in a magneto exchange.

It will be seen that the A and B lines are joined through the line coil of the self-restoring indicator I, and that the test wire T is earthed through the restoring coil. When a plug is inserted into a jack at any section of the switchboard the A and B lines are connected through the tip and shoulder of the plug, while all the bushes are connected through the test wire T to earth. The middle point of the operators' receivers are joined through a battery to earth, and when an operator at any other section of the switchboard touches with the tip of a plug the bush of an engaged subscriber she will hear a click in her receiver and know that the subscriber is engaged at another section of the board

Q.—Define current in terms of quantity. Name and define the practical unit of current. What is a coulomb?

A.—Electric current is the quantity of electricity passing any point of a circuit in each second, or

$$C = \frac{Q}{t}$$

where C is the current, Q the quantity of electricity, and t the time, all in consistent units. If C is in amperes, Q is in coulombs.

The Board of Trade definition of the ampere is *that unvarying current which, when passed through a solution of nitrate of silver in water, deposits silver at the rate of* .001118 *of a gramme per second.* Practical derived units from the ampere are the milliampere ($=10^{-3}$ of an ampere) and the micro-ampere ($=10^{-6}$ of an ampere).

The coulomb is *that quantity of electricity transferred by a current of one ampere in one second,* or an *ampere-second.*

(*To be continued.*)

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

Commencing with Question No. 101, *a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.*

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 177.

I am in charge of a large D.C. motor plant, and I wish to design a starter that will start, in case of emergency, any motor from 5 h.p. to 75 h.p. Can any reader give me some helpful suggestions which can be embodied in the design?—"TESTER."

QUESTION NO. 178.

I am in charge of a 4-pole, ½ h.p. 85 period A.C. motor of the repulsion type. I cannot prevent the excessive sparking which occurs at all loads. Can any reader give me some helpful suggestions?—J. E. WILKINS.

[*Replies to Questions Nos.* 177 *and* 178 *must be received not later than March* 29, 1924.]

Answers to Questions.

QUESTION NO. 174.

Can any reader inform me of the process by which accumulators are treated to enable them to be put on the market in what is known as "a dry and fully charged condition," i.e., only requiring to be filled with dilute acid and to be given a short freshening charge?—"C. R. HARDY."

REPLIES TO QUESTION NO. 174.

The replies to this question did not contain any authentic information, and it has been decided to make no award. We have been in communication with some of the leading manufacturers of accumulators upon the subject of this special cell, and we cannot obtain information which may be useful to "C. R. Hardy." This may account for the poorness of the replies. It is, however, possible—as Mr. Hardy suggested in his letter sent with the question—that the accumulators are manufactured abroad and no information is yet available in this country.—EDITOR, ELECTRICITY.

Manchester Wireless Society.—At an extraordinary general meeting of this society held on the 7th inst. it was resolved: (1) That consuls be appointed in each district to assist members and also to popularise the society generally. (2) To reduce subscriptions to—members over the age of 17, 10s. 6d. per annum; juniors under that age, 5s. The entrance fee in both cases to be abolished. (3) That members be given the opportunity of studying transmission and be allowed to work the society's apparatus under the supervision of a competent operator. The society is being assisted by Mr. S. R. Mullard, vice-president (Mullard Radio Valve Co.), the Chloride Electrical Storage Co., and Mr. John Roberts, of Manchester. Full particulars can be obtained from the hon. secretary, Y. W. P. Evans, A.M.I.R.E., 2, Parkside Road, Princess Road, Manchester.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and Abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Tuesday morning, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No.: 2460 Gerrard.

Current Topics.

A Metal Famine?

A recent comment at the annual meeting of the British Metal Corporation foreshadows a famine in certain essential metals before the world is very much older if the present rates of consumption continue to increase. It is pointed out that the available known sources of supply are strictly limited, even in so far as the commoner metals are concerned. British ironfields, for example, are approaching exhaustion in some districts, whilst the world's consumption of copper, lead, tin, and zinc has risen since the war more swiftly than production. Whilst the general explanation is the enormous growth of industry, especially the engineering industries, some special cases were cited as immediately responsible for a shortage of one or two metals. The enormous demand for storage batteries in connection with motoring and wireless, for example, were blamed for the temporary shortage of lead.

Generally speaking, the development of the electrical age may be regarded as having thrown an increased strain on the world's copper supply, whilst the demand for tin is laid at the door of the food canning industry. The rarer metals, too, are by no means so plentiful in proportion to the demand as could be desired. Platinum is a case in point, and here again electrical applications are largely responsible for the shortage and enormously augmented market price. Platinum is of enormous importance, not only for electrical contacts, etc., but for dental work, in which it is largely employed, as well as in many chemical processes. It is of interest to note that in 1874 platinum could be bought for £1 5s. an ounce. It now costs approximately £28 per ounce. Although there is no immediate need for panic, it may so happen that future generations will have to turn to substitutes for some of the better-known metals now in common use, and only those which are plentiful in nature remain for the service of industry, aluminium being a noteworthy example.

A True Patriot.

In his address to the meeting of the Women's Patriotic League, Mr. C. H. Wordingham, C.B.E., rendered yeoman service to the industry by his advocacy of electricity for domestic requirements and labour-saving in the home. Although of a general character, the address was in the author's usual interesting vein, and well calculated to impress his influential audience. Always an optimist, Mr. Wordingham laid especial stress on the present and future possibilities of electrical service in the home, and it is safe to predict that his interesting discourse to an audience of British women will not be without its due effect in encouraging still further additions to the ranks of consumers in certain districts. The address was prepared at the request of the E.D.A., who are to be congratulated upon their selection of so able a sponsor as Mr. Wordingham.

Breakdowns.

Supply failures have not been quite so rife during the past few weeks, but they still occur with disconcerting frequency, recent examples being Halifax, Burton, and Wallasey. The last-named was the most serious, affecting the whole of the lighting, power, and tramways for upwards of four hours, and attributed to an explosion at the power station switchboard. The mishap occurred about five o'clock, when all electric lights were extinguished, and tramcars in the streets came to a standstill, remaining in their respective positions until the supply was restored at nine o'clock. As the breakdown occurred on a Sunday, church services and attendances were affected, whilst an operation had to be postponed at the Victoria Central Hospital. A switch failure is stated to be responsible for the Halifax breakdown, which was only of short duration, whilst the Burton breakdown is attributed to a cable fault.

Energetic Belgium.

Students of our industrial problems, including both employers and employed, might well turn their attention to the very excellent example set by Belgium in the face of the far more serious situation in which this little country found herself at the end of the war. Ever industrious, in the face of the most discouraging factors, she is possessed of a population with great innate capacity for work and fertile in initiative; a people, as history proves, with well-tried powers of resistance and an indomitable will. Taking as her slogan, "Fewer Imports, Increased Exports and Greater Production," Belgium, supported by a sound business Government, is rapidly re-establishing her industrial and commercial prosperity, so seriously affected by the great conflict.

To cheapen production the Government has brought in a Bill for centralising the generation and distribution of electrical energy with a view to its widest possible application for lighting and power, especially in Belgian factories. Important private enterprises have amalgamated with a similar object in view. Nor has the human factor been overlooked. Belgian employers fully realise the advantages of constantly improving the conditions of industry as making for increased production. Belgium's policy in regard to her Colonial territory is similarly progressive; the mineral riches of the Congo are being made a source of industrial wealth in the home country, and closely co-ordinated with the rich coalfields of the Campine. In this enterprise they not only encourage their own nationals, but also those of their Allies. I am personally acquainted with an English family which is profitably developing a fertile farming tract on the Congo under a very excellent Belgian land settlement scheme.

Our Export Trade.

While the British Empire Exhibition will unquestionably do much to promote British trade abroad, there is still need for far greater and more continued publicity in connection with the general export of British manufactures than the present selling and advertising policy of British manufacturers and merchants is able to influence. To this end a manifesto signed by many distinguished and influential men has been issued, suggesting the desirability of a Royal Commission on Selling and Advertising in Foreign Markets. It is pointed out that the only permanent cure for unemployment is to increase the demand for labour, which coincides with creating a greater demand for commodities. This in turn necessitates a vastly augmented export trade, which can only come about as a result of making British goods better known abroad by means of judicious advertising backed by an energetic foreign sales policy.

The manifesto sets out that some of our manufacturers advertise extensively in foreign markets, and, as they do so continuously, must be obtaining a profit. Before the increase in trade can affect the labour market appreciably, however, it is necessary that their example should be widely followed. Dubiety concerning the risks and difficulties involved prevents this, and arguments in favour lack the general confidence required for effective action. It is considered that the proposed Royal Commission could hear the evidence of manufacturers and others with experience of foreign trade, and that the evidence thus collated would be of practical benefit to British export trade as a whole. It is, furthermore, suggested that the present year is especially suitable for such an inquiry in view of the proposed International Advertising Convention to be held at Wembley in July.

The comparative scarcity of direct representation of well-known British manufacturing concerns in leading foreign countries, and our very considerable dependence upon export merchants for finding and fostering channels abroad for the distribution of some of our more important British products, supports this suggestion. By comparison with Germany and America, British manufacturers are by no means well represented from the foreign sales standpoint in many of the world's leading markets. Too many firms rely upon the assistance of general agents, who cannot possibly specialise in any one of the many lines they essay to handle, and who do not possess the necessary technical sales ability to do justice to the goods they are handling. The establishment of effective sales organisations in some of the most promising foreign markets is no mean problem for the smaller British manufacturer, and such a Commission might be able to point a solution to this one of many similar pressing problems of our export trade.

The E.D.A. Luncheon.

Again I extend my most cordial congratulations to Mr. Beauchamp on the success of the annual meeting of the E.D.A. and the luncheon which followed it. Space does not permit me to report it at length, but it was a very live affair, and the president, Alderman W. Walker, who was in the chair, made a most vigorous speech, in the course of which he uttered some very caustic remarks on the subject of the attempt to introduce Free Trade political propaganda into the Exhibition at Wembley, and then went on to tell us what a wonderful show it would be. Sir James Stevenson replied, and said that, barring strikes and events over which he had no control, the doors were bound to be open to the public on or before April 26, because they would be admitted to the Cup Final on that day and the Stadium could not now be dissociated from the Exhibition buildings and grounds.

Sir Malcolm McAlpine, as a contractor, spoke in terms of high praise of the way in which labour was doing its bit towards completing this gigantic undertaking, there being between 14,000 and 16,000 now employed in the work, while Mr. Garcke gave us a long disquisition on the prospect of the electrical trade generally, and he was followed in an optimistic strain by Mr. S. T. Allen, of Wolverhampton, who had just been elected chairman of the E.D.A. Council for the ensuing year. Altogether a very happy gathering.

Elektron.

B.E.A.M.A. ANNUAL MEETING AND LUNCHEON.

The annual meeting of the British Electrical and Allied Manufacturers' Association took place at the Connaught Rooms on the 20th inst., Mr. Longbottom, chairman of the council, in the chair, and was followed by a luncheon to members and the Press.

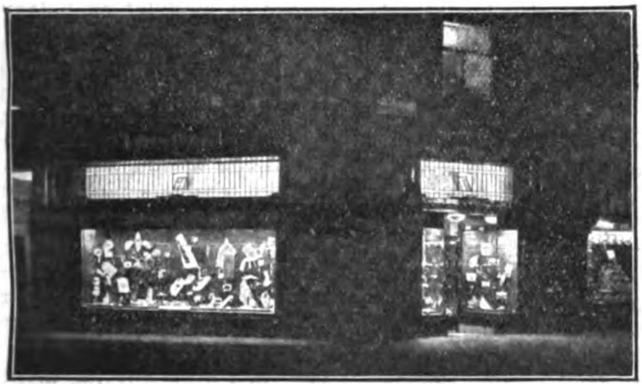
The business at the annual meeting was of the usual formal character, and included the presentation of the accounts and annual report, the election of members of council and of auditors.

At the luncheon which followed, the chairman, replying to the toast of "The B.E.A.M.A. Council," proposed by Sir Philip Nash, said that it had occurred to him that additional interest might be added to the annual meeting if he imposed upon himself the duty of giving members a short address on the year's progress in the electrical and allied industries. He hoped that succeeding chairmen would forgive him for the innovation and would not feel in any way bound by it. Mr. Longbottom then gave his address (which will be referred to in next week's "Current Topics"), after which a vote of thanks to the chairman, proposed by Mr. P. J. Pybus, brought the proceedings to a close.

Removal.—The Library Press, Ltd., have moved from 26, Portugal Street to new and larger premises at 83, Southwark Street, London, S.E.1.

A REMARKABLE LIGHTING INSTALLATION.

Retailers generally are well aware of the value of window space, but it is not perhaps so widely recognised that full advantage thereof can only be taken if the display be adequately and attractively illuminated at night. The displays of Messrs. Austin Reed, Ltd., are amongst the finest of their kind in the country, and their value at night is greatly enhanced by the system of lighting employed. The illumination of this firm's newly-acquired premises in Kingsway, as shown in our illustration, is an excellent and convincing example of what correct lighting can do to add to the attractiveness and advertising value of a well-arranged display.



The excellent results obtained are due very largely to the fact that the installation was planned in consultation with the architects, Messrs. Westwood and Emberton, who were thus able to fit the lighting scheme harmoniously into their general plans. The plans for the building and for the lighting installations were in a very real sense complementary.

The lighting equipment used in the windows and showcases, and also throughout the interior of the shop, comprises two main items. (1) The B.T.-H. X-ray mirror reflector, and (2) the Mazda lamps, the actual installation work having been carried out by Messrs. Tyler and Freeman, of 40, Chancery Lane, W.C.2.

The illustration is from an untouched photograph, and shows the soft even diffusion of light, the display being thrown up clearly without any objectionable glare. The units used are "Hood" reflectors, each equipped with 60-watt Mazda gasfilled lamps, and fixed along the top front edge of the window, being concealed by a narrow curtain, as can be seen. No outside lights are used, and the interior lights are invisible to the people in the street. The same soft glareless effect is maintained inside the shop, the source being hidden, although every corner of the interior is well lighted, the result being that the customer may compare and select any article without the distressing presence of bare or improperly shaded lamps. It is interesting to note that the store cases were designed specially to accommodate the reflectors.

Annual Dinner.—The No. 4 (Newhaven) Company, L.E.E., R.E. (T.), will be holding their annual reunion and dinner at the Florence Restaurant, W.1, on Saturday, April 12. Old members are asked to communicate with Mr. A. E. Beach, Shawfield Street, Chelsea, S.W.3.

PROBLEMS IN TELEPHONY, SOLVED AND UNSOLVED.*

By PROFESSOR J. A. FLEMING, M.A., D.Sc., F.R.S.

(*Continued from page* 156.)

It is possible to sift out currents of certain ranges of frequency by means of devices called *electric filters*, which are short, artificial lines built up of inductance coils and condensers arranged in certain ways. Thus if the inductances are placed in series and the condensers in shunt (see Fig. 13) we have a filter called a *low-pass filter*, because it permits low-frequency currents to be transmitted through it, but very rapidly attenuates currents of high frequency.

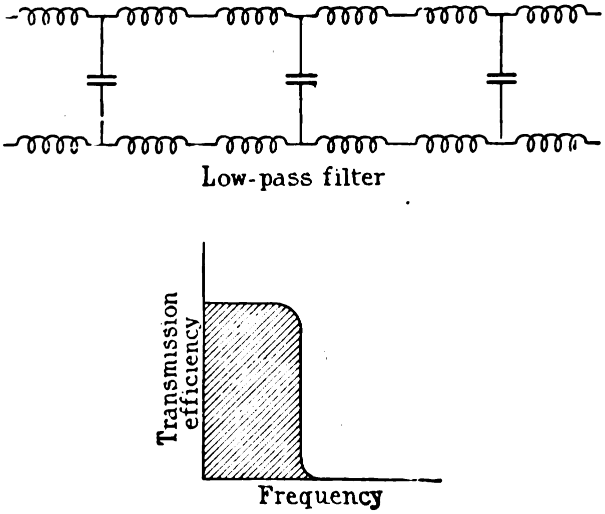


FIG. 13.—DIAGRAM OF A LOW-PASS FILTER CIRCUIT.

If we arrange the condensers in series and inductances in shunt (see Fig. 14) we construct a *high-pass filter*, so called because it blocks out low-frequency currents below a certain frequency.

Again, by arranging certain inductance-capacity shunts, as in Fig. 15, we construct a filter called a *band filter*, so called because it has the property of allowing currents the frequency of which falls within a certain band, or limits, to pass, but rapidly attenuates those of higher and lower frequency.

It has been primarily due to the invention and study

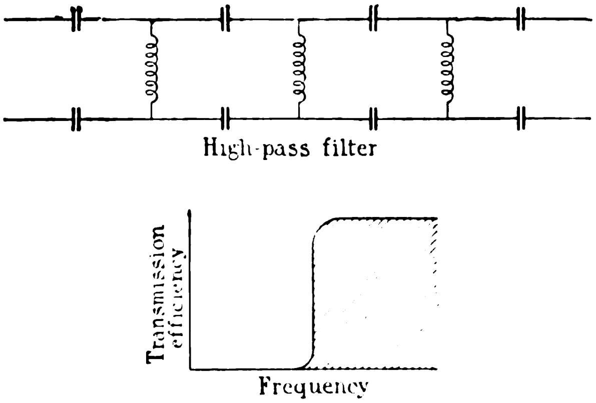


FIG. 14.—DIAGRAM OF A HIGH-PASS FILTER CIRCUIT.

---

*Lecture delivered before the Institution of Electrical Engineers, to whom we are indebted for the illustrations.

of these filters, especially by G. A. Campbell and others, that carrier-wave telephony has been rendered possible.

Returning, then, to our modulating valve, let us suppose that the low-frequency applied grid voltage has not a pure sine-curve form, but is complex and therefore resolvable into components of different frequencies, as in speech waves, lying between the limits of 200 and 2,000, or thereabouts. It is clear, then, that the q in the original formula is to be taken as representing a whole range or band of frequencies forming a sort of electrical spectrum, and the same applies to the $p + q$ and $p - q$ frequencies in the formula. It is possible to arrange a band filter which, when interposed in the circuit of the plate current of the modulating valve, will block out all frequencies except those of $p/2\pi$ and $(p + q)/2\pi$, viz., those of the pure carrier current, and are of the bands due to the addition of the range of voice frequencies to the carrier frequency. In the instance given this would mean that the filter transmits frequencies of the band from 12,000 to 10,200, and also 10,000 for the carrier current. Currents of these frequencies can then be transmitted along an ordinary telephone line without interfering with the propagation of the ordinary telephone currents of voice frequency. Let us consider in the next place the result of allowing the group of high-frequency currents, or rather electromotive forces created by them by means of a suitable transformer, to act on the grid of a thermionic valve at the receiving station, called a demodulating valve. We have seen that when frequencies $p/2\pi$ and $q/2\pi$ act on the grid at a point on the lower part of the characteristic curve, we have produced a plate current involving 4 different frequencies, viz., $p/2\pi$, $(p + q)/2\pi$, $(p - q)/2\pi$ and $q/2\pi$. Hence it is clear that if voltages involving frequencies $p/2\pi$ and $(p + q)/2\pi$ act as a grid, the resulting plate current will contain frequencies $p/2\pi$, $(2p + q)/2\pi$, $(p + q)/2\pi$ and $q/2\pi$, all but the last are relatively high-frequency currents and can be filtered off from the band of voice currents of frequency $q/2\pi$.

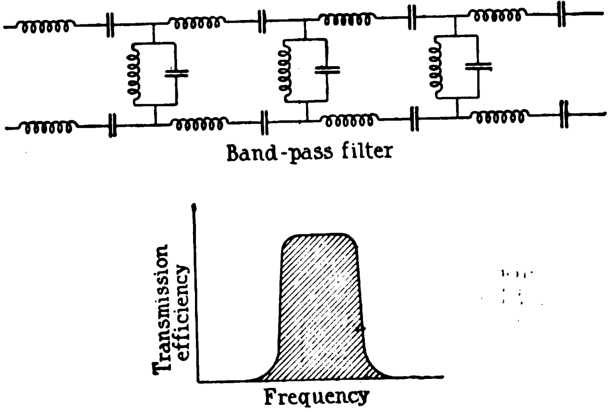


Fig. 15.—Diagram of a band-pass filter circuit.

These last can then be rectified and allowed to act on a telephone ~~receiver and thus re-create the speech~~ sounds made to the transmitter coupled to the grid of the modulating valve at the sending end. Hence the broad principles of multiple carrier-wave telephony can be outlined as follows:—

At one end of an existing long-distance telephone line used in the ordinary way for telephonic speech we can attach a certain number of modulating valves with their plate circuit coupled to the line through appropriate transformers and filters. We can then generate by means of a number of oscillating valves high-frequency carrier currents of certain different frequency, and apply electromotive forces due to these in series with the electromotive forces of low or speech frequency, produced by ordinary carbon microphone transmitters so as to give to the grids of the several modulating valves carrier-frequency plus voice-frequency voltages (see Fig. 12). These carrier frequencies $p/2\pi$ must be so selected that the respective bands of modulated frequencies represented by $(p + q)/2\pi$ (where $q/2\pi$ is the range of voice frequency) do not overlap. We then transmit all these currents along the telephone line and at the receiving end separate out the several groups of oscillations by suitable band filters and apply the electromotive forces created by suitable transformers to the grids of demodulating valves. In the plate circuits of these last valves we have coupled ordinary telephone receivers, which are acted upon by the voice currents disentangled by these demodulating valves from their respective carrier currents (see Fig. 16).

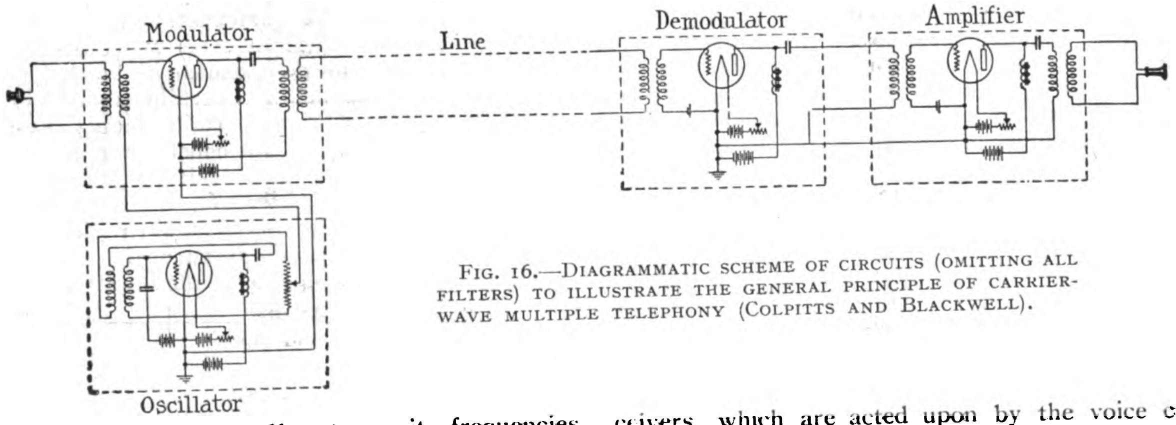


Fig. 16.—Diagrammatic scheme of circuits (omitting all filters) to illustrate the general principle of carrier-wave multiple telephony (Colpitts and Blackwell).

Each telephone receiver then repeats the speech sounds made to the corresponding microphone transmitter at the sending end.

In this manner we can make a single telephone line convey simultaneously a number of telephonic conversations through the agency of a number of superimposed separate carrier currents, the frequencies of which are far enough apart to prevent the corresponding bands of modulated currents from overlapping as regards frequency.

(To be continued.)

C.T.S. IN THE TROPICS.

This was another of the papers sent in for the C.T.S. competition, and the contributor, Mr. C. Sylvester, was kindly awarded a consolation prize of one guinea by the St. Helens Cable Co. Mr. Highfield criticised it as follows :—

This paper describes the application of the C.T.S. system to a sugar factory.

It is an interesting example of special work, and contains a good deal of information that is valuable. It is well written, but would have been better if it had been arranged in a more formal manner. There is no attempt to deal with the subject generally, nor are the author's conclusions summarised at the end.

The paper is "Fair," and is given 40 per cent.

C.T.S. IN THE TROPICS.

On several occasions during recent years I have had an opportunity of testing the ability of C.T.S. to meet exceptional requirements. Two occasions were in 1919, when I went out to Jamaica, British West Indies, to take up an appointment with an electrical engineering company. The chief work was in connection with the electrification of sugar machinery, replacing obsolete horizontal steam engines with turbo-generators which, through transformers, were to supply electric light to the sugar factories and the plantations.

When I arrived in Jamaica I was surprised to find that practically the whole of the electrical equipment was American, even to the wire used for wiring houses, factories, etc. As everyone knows who has had any experience of American practice, the wire used up to, say, our 7/20, is in one strand, and it is very difficult to work if one wishes to deviate from standard American practice.

This wire was quite satisfactory run on poles fitted with glass insulators in the plantation, but a different proposition was presented in the sugar factory, where, to work efficiently, it was necessary to have wandering lead. The stiff American wire, apart from other considerations, although bound in pairs, was not suitable in the sugar factory for either wandering leads or other purposes.

One reason for this is that the factories are not totally under cover, and oftentimes temporary lights are required in positions where fixed lights are an impossibility; hence one has to resort to plugs and leads from the nearest light source. One of these positions is usually on the top of the boilers, where the trash (crushings) from the cane is pressed into the fuel hoppers. Here the wandering leads have to meet stringent requirements if they are to remain efficient. For one thing they are being continually trampled under foot, the bare feet of negroes it is true, but, nevertheless, a good test for rubber. Again, apart from the exceptionally high temperatures of the tropics, the intense heat from the boilers very quickly affects the insulation of ordinary wire, and "sparks" and "shorts" are the order of the night.

Another position in the sugar factory where temporary leads have to be used is in connection with the sugar-boiling plant. Here the cane juice is pumped from a well under the crushing rolls and passed through many operations before it gets to the solid state. Sugar is not a good insulator, and I have seen many a "short" through ordinary insulated wire being dropped into sugar pans.

The worst position to light in the sugar factory is the space under the mill gearing. Here, again, temporary wire has to be used; and I can assure you that the continual pulling over gears, through grease, filth and oil will test wire which has not outstanding merits.

After some little time I found the American wire was not suited for use in the sugar factory from either an insulation or flexibility point of view, and I decided to try C.T.S. I think my first order was for 400 yards, and I found it meet all requirements. A little trouble was at first experienced with the plugs to which it was necessary to attach the C.T.S., since here, again, American plugs were never intended for its use. The difficulty was overcome by using a special connection box with bush grummets, which made quite a tight job of it.

The other occasion referred to where I found C.T.S. satisfactory under extraordinary conditions was at the Annoto Bay hydro-electric scheme, when excavations were being carried out in an effort to reach a water supply through the mountain side. A tunnel had been made, and the water was coming through in a fairly large volume. Kerosine lamps were tried for illumination purposes, but they were not portable enough. The only remedy appeared to be to use electric light.

I therefore obtained a Delco set, generating at only 32 volts, $\frac{3}{4}$ kw., and hung a number of lamps upon two lengths of American wire similar to that previously referred to, but it was not satisfactory. Here it was not a question of high-voltage, but the ability of a wire to withstand falling dirt, stone and constant immersion in mud and water. We had only 50 yards of C.T.S. in the store, but it was quite sufficient for our purpose, and it was in use with three high candle-power lamps when I left the West Indies a few weeks afterwards.

Candidly, when I ordered C.T.S. for the tropics in the first place, like the Scotsman, "I had ma doots." I had found it satisfactory under ordinary atmospheric conditions in England, but I did doubt its ability to resist excessive heat. In this, however, as subsequent events proved, I was entirely wrong, and I would not hesitate to use it on future occasions where heat, oil and water prevent the use of ordinary material.

THE FUTURE OF MAIN-LINE ELECTRIFICATION ON BRITISH RAILWAYS.*

BY LT.-COL. H. E. O'BRIEN, D.S.O., MEMBER.

Extensive main-line electrification has hitherto been considered to be a rather remote possibility in Great Britain, it being supposed that the capital expenditure involved and the price of current would be prohibitive. The great superiority and simplicity of the electric as compared with the steam locomotive as a machine has not been realised. The author shows that the probable density of traffic in ton-miles on the main railway arteries is so great that the cost of energy, including all capital charges, will not be prohibitive; also that the cost of the electric locomotives will not be a capital charge; and, further, that when the reductions in the cost of locomotive operation and maintenance (due to the simple construction of the electric locomotive) are taken into account, the total cost of locomotive operation is substantially less for electricity than for steam. The conclusion is that, though it has only been possible to base the argument on general statistics, the problem merits closer and more immediate investigation than has hitherto been accorded to it.

---

* Summary of paper read before the I.E.E.

Reviews of Books, &c.

[*Books noticed in this column will be sent from* ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.*]

DIRECT CURRENT DYNAMO AND MOTOR FAULTS. By R. M. Archer, B.Sc., M.I.E.E. (Pitman, 7s. 6d. net.)—This is a well written and profusely illustrated work dealing, from first principles, with the causes, symptoms, diagnosis and treatment of faults and troubles commonly experienced in the operation of D.C. dynamos and motors. The characteristics of the dynamo and motor are very peculiar, and it is only those who have the circuits in their minds eye, so to speak, who can hope to cope with faults when they arise. The work under review will certainly assist those who have an elementary knowledge of the operation of dynamos and motors to get a better grip of the subject. The chapters dealing with the defects in field and armature windings are written in a clear, concise manner. The diagrams referring to these matters are simple and easily understood. Although the author states that "the treatment throughout is elementary and the aim is to encourage the experimenter to apply first principles in a systematic way," we are of opinion that the book will find a ready sale among students of technical schools, say, second-year students. It will supplement the notes they obtain during the session, and will prepare them for the more intricate calculations concerning design which they have to study during the third year session.

THE ELEMENTS OF AUTOMATIC TELEPHONY. By Arthur Crotch. Demy 8vo, 80 pp., 42 illustrations. (Spon, 3s. 6d. net.)—This new manual will appeal to that wide circle of readers of this paper who are anxious to gain a clear insight into the main principles of automatic telephony, but cannot afford to purchase offhand the high-priced text-books which deal exhaustively with the subject, and to which they hope to aspire in the near future. To such a class the book will prove most useful, as Mr. Crotch does his best to impart instruction in a manner which can be easily understood, while the diagrams back up the text remarkably well. The book deals only with the Strowger, Siemens and Relay systems, no mention being made of the Western Electric or Peel Conner exchanges, but that information which it does give is good, and in each case the operations are described from the lifting of the receiver to make a call to its replacement after the conversation. The book should therefore help students and operators to acquire a sound, practical working knowledge of the subject.

SMALL ELECTRIC MOTORS. By E. T. Painton. 120 pp., 55 figs., 2 tables. (Pitman, 2s. 6d.)—Whatever expectations of a large sale were held by the publishers when they decided to add this volume to their extensive series of technical primers, they ought not to be disappointed. A gap in the hitherto available technical literature on electric motors is now filled. The machines dealt with are of the class generally known as fractional horse-power motors, i.e., up to one horse-power, as now so extensively used for the individual drive of small machines, portable electric tools, vacuum cleaners, sewing machines, washing machines, etc. Although these motors operate on the same principles as the larger machines their operating characteristics often differ widely, so that an exposition of the general principles governing their performance, as is lucidly expounded in this volume, is most welcome. Besides elementary principles and operating characteristics of D.C. and A.C. motors, polyphase and single-phase, mechanical details are well treated, a large number of excellent diagrams being included. A chapter on the care of small motors is a feature which will appeal to many, as will the description and diagrams of the various starting arrangements necessary with the various classes of A.C. motor.

LOCKWOOD'S BUILDERS', ETC., PRICE BOOK, 1924. (Lockwood, 8s. 6d. net.)—This veteran price book has always found a ready sale among electrical engineers and installation contractors owing to the care with which the chapter on electrical installation work is revised and kept in line with the latest practical data. As stated in the preface, prices are now somewhat more stable than they were twelve months ago, and are approximately from 70 per cent. to 80 per cent. above pre-war figures. Details are given of practically all the apparatus and appliances which now go to form an up-to-date installation for any private house, so that an architect can obtain a fairly reliable working basis without much difficulty. We can thoroughly recommend the book to our readers.

Trade Notes.

From **Siemens Brothers and Co., Ltd.**, of Woolwich, we have received three new publications, viz.:—

Pamphlet 720A.—Electric mine shaft signalling apparatus, which is a revised edition of the July, 1919, edition containing description and illustration of Siemens' visual indicators for electric signalling. This apparatus was designed to meet the requirements of the Coal Mines Act, 1913, and it has been in use ever since the regulations were first put into operation. It has been found fully to meet the requirements of the Act. The dial indicators can be used in conjunction with mechanical signalling apparatus.

Pamphlet 830A describes Siemens' pyrometers for internal combustion engines. These are used to measure the temperature of the exhaust gases. Any appreciable variation from normal will point to misfiring, faulty carburettion, or similar inefficient conditions in the combustion chambers. A pyrometer is provided for each cylinder, and a multiple-way switch enables the temperature of each cylinder to be read off separately. No external supply of current is required, the pyrometers being of the thermo-electric type.

Pamphlet 840B describes electrical distance thermometers which have been specially designed for temperature measurements on board ship in cold storage chambers, steam pipes, condensers, feed-water tanks, oil-fuel tanks, etc. The thermometers may be placed at any distance from the indicator and switchboard, and the temperature of any number of thermometers may be read on a single temperature indicator.

A catalogue of "Everyday" electric light fittings has been issued by **Messrs. Smith and Ansell, Ltd.**, Stockfield Street, Acocks Green, Birmingham, and should prove of direct interest to contractors and factors generally. The series of fittings has been designed to meet the likely demands from districts where people have only moderate means, or where the house owner has not much money to spare for fittings, and must therefore purchase those of an inexpensive nature. The makers claim that, although the prices are keen, the quality of the material and the actual workmanship are really good. Also, the fittings are neatly and carefully packed in tissue and cardboard boxes, and are not likely to deteriorate in stock. It is certainly a line which should attract dealers.

The March current stock price list of electrical supplies has just been issued by the **Sun Electrical Co., Ltd.**, of 120, Charing Cross Road, London, W.C.2, and will be appreciated by all contractors and dealers in electrical supplies generally.

List No. 30A of Cab Tyre Sheathed Cables has just been issued by **Messrs. Johnson and Phillips, Ltd.**, of Charlton, S.E.7. It is a well-printed work of 40 pages, containing comprehensive details of the various types of these cables of the association grade which have been manufactured by them for many years past. Details are also given of certain useful fittings supplied by them for use in installation work. The catalogue should, therefore, be of direct interest to all wiring and installation contractors.

Folder L303, from the **B.T.-H. Co., Ltd.**, gives illustrations and details of the new "Keldon," "Ace" and "Trojan" fittings, all of which are totally enclosed units, and are particularly recommended where glareless and well-diffused lighting is needed. Contractors and illuminating engineers should ask for the list.

Pamphlet P. 188, from the **British Insulated and Helsby Cables Co., Ltd.**, of Prescot, gives a list of the company's factories, branch offices and agencies throughout the British Empire, as well as a very complete schedule of the manufactures which are supplied by the various works. A glance through it shows what a very comprehensive range of goods can be obtained from the company, from aluminium in cables, sheet, matting and sections, down to insulating varnishes, electric welders and window lead, to say nothing of telegraph and telephone material, cables of all kinds, golf balls, and electricity meters.

Price list No. 9, dated March, 1924, and dealing with A.C. and D.C. motors, has just been issued by **Higgs Bros.**, of Sand Pits, Birmingham. It is an exceptionally complete list, covering as it does the machines already referred to, as well as starting gear for use therewith, and it should therefore prove of direct value to all installation contractors and users of motors generally. It also contains details of the same types of dynamos, and likewise motor-generator sets.

Publication 7474/1, which describes Steam Operated Air Ejectors, has been published by the **Metropolitan Vickers Electrical Co., Ltd.**, of Trafford Park, Manchester, and should prove of interest to central station engineers generally. It is clearly printed and well illustrated.

In order to render the greatest possible assistance to retailers who are participating in the present Osram publicity campaign, the **G.E. Co.** are issuing two types of enamelled iron outside signs dealing respectively one with the Osram white or clear gas-filled and vacuum lamps, and the other with the Osram Automobile lamp. The designs are bold and striking, being carried out in artistic colours in permanent vitreous enamel, while a flange at one side gives ample provision for fixing to the wall outside dealers' premises, thus unmistakably identifying the dealer as an Osram Lamp reseller. These signs are immediately available, and all dealers requiring them are invited to apply at an early date, stating which design they desire.

Leaflet No. 97 issued by **Gent and Co., Ltd.**, of Leicester, gives illustrations, details and prices of the Tangent Tuning Coils for General Radio Reception, for which the makers claim that extremely sharp tuning is obtainable within the specified wavelengths. The list should, therefore, interest all retail dealers in wireless supplies.

From the **G.E. Co., Ltd.**, we have received an interesting article on the value of colour lighting in the home, together with a leaflet regarding the Osram Colour Sprayed Gasfilled lamps. For these the company claims that the present moment is most opportune for all dealers in electrical supplies, as the coming spring cleaning season presents a unique opportunity to the housewife to make any desired changes in her decorative schemes. With these special coloured sprayed lamps very charming effects may be obtained when used in semi-indirect bulb fittings, and the colour lighting arrangements of the room may be varied as occasion demands without any difficulty whatever. This is a point which can well be emphasised by all contractors and supply dealers.

The Benjamin Bulletin for February has come to hand from the **Benjamin Electric, Ltd.**, of Tariff Road, London, N.17. The second issue is devoted mainly to commercial illumination, covering shop exterior and interior showrooms, offices, public halls, etc., and as such it is of direct interest and value to all installation engineers and contractors. The bulletin will be sent post free to any trade reader on request, and, in addition, it is accompanied by a postcard advertising a special half-price offer of the Benjamin Dim-a-lite Portable Lamp, of which an illustrated description has already appeared in this paper.

Leaflet No. 634 describes the Armstrong Table Stove, which is now being placed on the market by the **Benjamin Electric, Ltd.**, of Tottenham, London, N.17, at a list price of three guineas, and should be a good selling line for all contractors and dealers in electrical accessories, as it is very attractive in its arrangement as well as economical in current consumption. It can, therefore, be used on an ordinary lighting circuit without undue expense, and as it is capable of performing three cooking operations at the same time, it is quite likely that it will prove attractive to a very large number of housewives. For instance, one special point in its favour is that it toasts both sides of bread at once. Also, it does not discolour from heat, and is easily cleaned. The list should be written for without delay.

A new folder of the **B.T.-H. Co., Ltd.**, gives illustrations and prices of Radio Valve type B4 for amplification, and it should, therefore, prove of value to all dealers in wireless goods, to whom it can be supplied with business name and address overprinted on receipt of proper trade application, which should be made to the company at Rugby.

We are pleased to hear from the **Hendon Electrical Co., Ltd.**, of 104, Southampton Row, London, W.C.1, that they have received numerous inquiries from all parts of the United Kingdom for the Spot-o'-lites, to which we made reference in our issue of November 30, last. The company state that they have now ready a supply of showcards about 8 in. by 10 in. with boxes of one dozen attached, and as these are in striking colours which are likely to attract attention to the article, as well as being suitable for display in any showroom, they should prove a good line for dealers generally. The company will be pleased to supply them to the trade, together with suitable literature on application.

Revised price lists are to hand from the **Sun Co.** giving details of the altered figures applying to the different electric light fittings, shades and accessories of which they hold such a splendid stock. There is also a leaflet 2 B giving prices of their small power motors and electric lamp locks, which should prove of direct interest to installation contractors generally.

A neat blotting slip advertising the Brittain motors is being issued by **Brittains Electric Motor Co.**, of 110, Cannon Street, London, E.C.4, and is certain to be much appreciated by all recipients.

Two well-printed and comprehensive catalogues have just been issued by the **Edison Swan Electric Co., Ltd.** One of 20 pp. illustrates the latest electrical heating and cooking appliances, as well as useful accessories such as electric irons and vacuum cleaners, while the other is an excellent list of 96 pp., giving illustrations of the very wide range of artistic fixtures, fittings, brackets, pendants, electroliers, and standards, for which the company have for so many years held a high reputation. There are also several pages of illustrations of switchplates, lamp-holders, glassware, and fittings accessories, all of which will appeal to electrical installation contractors, to whom the company will be pleased to send copy of either or both catalogues on receipt of proper trade application.

List No. 10/02, which has just been issued by the **Metropolitan Vickers Electrical Co., Ltd.**, of Trafford Park, Manchester, gives illustrations and clear details of the M.V. Model Motor, which has an output of approximately 1/40 horse-power at 2,000/2,500 r.p.m. These motors have been designed by the company's experts, and are made at their works at Trafford Park, and are admirably suited for small applications where a light drive is required, such as window signs, publicity devices, recording instruments, polishing spindles, etc. We think, therefore, that they should find a very ready market among factors and dealers in electrical supplies generally, and would certainly recommend early application for copies of the list.

An interesting pamphlet has been issued by the **Cambridge and Paul Instrument Co., Ltd.**, showing the position of their stand at the British Empire Exhibition, and also giving details of the various other stands at which Cambridge instruments are in actual use. There is no doubt that these goods will attract the attention of a very large number of engineers who are interested in this particular class of apparatus.

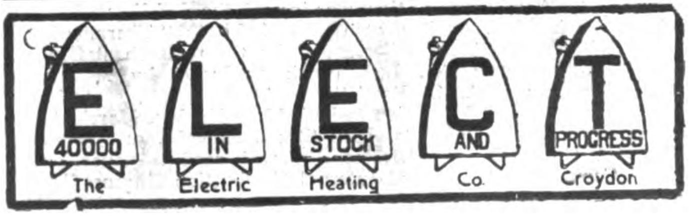
Meetings.—A wireless section meeting of the I.E.E. will be held on Wednesday, April 2, at 6 p.m. Subject: "Thermionic Valves with Dull-emitting Filaments," by the research staff of the General Electric Co., Ltd. (work conducted by Messrs. M. Thompson and A. C. Bartlett).——At the meeting of the Inst. of Engineering Inspection to be held on Friday, March 28, at the Royal Society of Arts, John Street, Adelphi, at 8 p.m., Mr. Hal Gutteridge, A.M.I.Mech.E., will read a paper on "The Commercial Testing of Internal Combustion Engines."

THE RELAY AUTOMATIC TELEPHONE AT WEMBLEY.

One exhibit at Wembley of that very enterprising undertaking, the Relay Automatic Telephone Co. is in the Building Section, Palace of Industry, at stand S. 778, where the erection of a 200-line private automatic telephone exchange was commenced on December 1, 1923, and the exchange was completed two weeks later. This exchange provides the entire automatic internal telephone service for the exhibition, and links up the Administration, Indian Empire, Dominions, Colonies and many large individual exhibitors. Connections in any part of the exhibition are made in four seconds, and the exchange gives a continuous day and night service without the aid of any human operator. This exchange on stand S. 778 will be open to the inspection of all visitors, and will be one of the wonders of the exhibition. The company also have a stand in the Palace of Engineering (Avenue 14, Bays 11-12), in which the exhibits will consist of "Relay" Public Automatic Exchanges, Private Automatic Exchanges, and Private Automatic Branch Exchanges. The public exchange will be of the type supplied to the British Post Office, the Govt. of India, Govt. of South Africa, and the P.T.T., France, and will be shown working with a small satelite exchange. The private automatic branch exchange will be of a type similar to that manufactured and installed by the "Relay" Company for the Post Office in the Bank of England, Debenhams, Ltd., Babcock and Wilcox, etc., and will have multi-office working with the private automatic exchange. The private automatic exchange will be a 50-line, 6-trunk model, equipped with 30 lines, and will embody several of the "Relay" Special Service features—secretarial control, conference lines, loud-speaking telephones, etc. The "Relay" code calling system will also be shown. It will be of interest to our readers to know that the "Relay" system has been adapted to the requirements of trans-Atlantic liners, and at present the "Relay" Company is constructing a private automatic installation for Britannic House, for the Anglo-Persian Oil Co., Ltd., which will be the largest of the kind in England, while exchanges have been supplied to the Govts. of Portugal, Brazil, Siam, etc.

BOOKS Write to S. RENTELL & Co., Ltd. And ask for Catalogue No. 10.

WINCHES
THE LONDON ELECTRIC FIRM, CROYDON
FOR ARC LAMP THEATRE BATTENS WAREHOUSES ETC.



Various Items.

E.D.A. Sales Conferences.—The last conference of the present session will be held on Friday, April 11th, at 7.30 p.m., at the London School of Economics, when a paper will be read by Mr. W. Y. A. Anderson on "Selling Electric Power," Mr. B. Longbottom in the chair.

Situations Vacant.—We would direct the attention of our readers to our situations vacant column, in which they will notice that draughtsmen are required by a large firm of telephone manufacturers, and tracers (female) are required by a London firm of electrical engineers.

Inverness.—The T.C. have asked the Aberdeen T.C. to grant them the services of the city electrical engineer, Mr. J. A. Bell, in connection with the former body's taking over the North of Scotland E.L. and P. Co., Ltd.'s, undertakings in Inverness. The request has been granted.

Wanted Urgently.—One of our readers is anxious to get into touch with the British manufacturers of violet ray high-frequency generating sets, electric massage vibrators, and electric hair dryers. Inquiries should be addressed to the Editor of this Journal, who will forward same to the proper quarter.

Aberdeen.—The Corporation have accepted the tender by Messrs. Vickers, Spearing Boiler Co., London—the lowest of seven—to supply two water-tube boilers and plant for £26,730 10s. The committee state that in 1920 offers were invited for two similar boilers, and the estimated cost was then £41,870.

Meetings.—The Junior Inst. Engineers will meet on Friday, 28th inst. Lecturette: "Wood-wool; Its Manufacture and Application," by A. J. Simpson (Member). Exhibits. Also on Friday, April 4th. Lecturette: "Mineral Oils, with Special Reference to Lubricating and Insulating Oils," by A. J. Sear, A.R.C.S. And on Friday, April 11th, a discussion on Mr. L. M. Jockel's paper on "Water-Tube Boilers," read March 14th. (Slides.) All at 39, Victoria St., at 7.30 p.m.

Italy.—A report on the commercial and industrial situation in this great kingdom has just been issued by the D.O.T., and may be obtained from H.M.S.O. or ELECTRICITY office, price 2s. 8d. post free. On page 18 it shows that Italy is rapidly improving her output of electrical apparatus of all kinds and that the principal imports are from the United States, Germany and Switzerland. Owing to high cost of production over here it is becoming increasingly difficult to sell British electrical materials to the Italians.

Copenhagen.—The municipality of Copenhagen has just placed a very large contract for complete boiler house equipment for the municipal electric power supply station with Vickers Spearing Boiler Co., Ltd., London, an affiliated company of Messrs. Vickers, Ltd. The contract includes boilers of 2,000 h.p. each, with economisers, stokers, air heaters, superheaters, mechanical stokers, and all accessories. The whole of this plant will be manufactured in Great Britain. The contract was obtained in open international competition, and was awarded on the merits of the proposal.

Willesden.—In view of the great attention now being given to pulverised fuel firing for steam generation, especially in power station work, and the enormous progress that has been made in the United States during the past three or four years, together with the recent developments in France, it was obvious that sooner or later another British power station would join the select company of Hammersmith. This event has now taken place, and the North Metropolitan E.P.S. Co. have ordered from Messrs. the Underfeed Stoker Co., Ltd., of London, the first "Lopulco" pulverised fuel installation in Great Britain, for their station at Willesden.

Quotations Wanted.—The Wairoa, N.Z., Borough Council invites tenders for the supply and delivery of:—1 low-lift single-stage centrifugal pump, 1,450 r.p.m.; 1 high-lift four-stage centrifugal pump, 1,450 r.p.m.; 1 set of spare runners for each pump; 2 electric motors; 3-phase induction motors, suitable for each pump. Alternative tenders are invited for supplying both pumping sets in duplicate, and for supplying the low-lift pump only in duplicate. That is, tenders are required for:—1 low-lift and one high-lift pumping set; 2 low-lift and 1 high-lift pumping set; 2 low-lift and 2 high-lift pumping sets.—The Auckland Electric-Power Board, Auckland, N.Z., invite tenders for the supply and delivery of 1 five-ton electric travelling crane. Specification, etc., at the D.O.T. (Room 52), 35, Old Queen Street, S.W.1.

A POPULAR SCIENTIFIC WEEKLY JOURNAL

ELECTRICITY

A PRACTICAL TRADE JOURNAL

APRIL 4, 1924.

CONTENTS. PAGE

The C.T.S. Competition 173
The Use of Light in Modern Advertising 174
The Geophone Low-Frequency Transformers 174
Problems in Telephony, Solved and Unsolved 175
Heavy-Oil Engine Indicator Diagrams 176
Current Topics 179
The Day 181
Questions and Answers by Practical Men 182
Reviews of Books 183
Electric Daylight at the Zoo 184
Various Items 1 4
Trade Notes 184

THE C.T.S. COMPETITION.

Another paper to which a consolation prize was awarded by the St. Helens Cable Co. was criticised by Mr. Highfield as follows:—

This paper contains a great deal of information, but is of a rambling character, which seriously detracts from its value. The author has not summarised his thoughts so that the merits and demerits of the system naturally fall into two columns.

The marks given are 37 per cent.

Cab Tyre Sheathed Cable.

St. Helens Cab Tyre Sheathed Cable, when used on any job, makes a financially sound scheme, ensuring economy and safety in manipulation.

A contractor who uses C.T.S. cable has not the same worry as one who does not, and knows that he is on a safe, sound investment which gives him a reputation for superior work. He only has to wait for the cable to be delivered, which can generally be supplied from stock, whereas the other has to wait for cable, conduit, casing and accessories before he can commence work. All that is wanted with C.T.S. now is to take the stuff to the job and fix it; less men and less tools are required, owing to it being most easily and quickly installed. The total cost of C.T.S. wiring installed complete is less than other protected systems such as screwed or brazed conduit, wood-cased or lead-covered wires. Being very flexible, it can be neatly worked around bends and over cornices, and is easily installed. No cutting away walls required, takes a lot less time, decorations are not interfered with and the cable is practically everlasting, also has no tapes or braids to upset insulation tests. This does away with the old-fashioned idea of conduit wiring, also requires no earthing or bonding, with the result of a much cheaper job of far greater efficiency. Where other cable is used, faults are not only a source of trouble and annoyance to the contractor, but their rectification frequently entails considerable expense. Braided cable in conduit, while generally assumed to be waterproof, will not long resist the action of condensed moisture, more particularly if it is slightly alkaline, with the result that the insulation is always in a saturated state when the waterproof qualities of the cable are destroyed. It therefore becomes a danger to the cable itself, for it acts like a sponge.

Cab tyre sheathing is ahead of any other for a protective covering for electric cables, and it must be appreciated that cab tyre has had to withstand for many years the severe wear and tear of acting as a rotating pad under steel-rimmed wheels, in slush, snow and rain, on bumpy roads and enduring the cold of winter or the heat of summer. The cables that are sheathed with this protective covering resist the action of steam, oil, acids, alkalis and other corrosive materials; it prevents the cable from getting kinked, and if the sheath gets cut the cut does not extend with wear. It therefore C—ontains T—he S—olution for all cable trouble and freedom from breakdowns. It is light in weight and has a smooth surface.

The disadvantages of some systems which are found in some cases, but are not too commonly found, are V.I.R. taped and braided, enclosed in wood casing. This cannot be used in damp situations, because the wood holds moisture, and in time the insulation of the wire perishes, the wire corrodes, thus allowing a small arc to form, which in turn may fire the wood casing; also corners are left too sharp. V.I.R. taped and braided cables, drawn into metal conduits—abrasion, condensation and corrosion troubles are met with. V.I.R. taped, braided and armoured cables—special fittings are required, mechanical and electrolytic troubles. V.I.R. taped and braided on cleats is only suitable for selected positions, whereas with C.T.S. it is free from all above troubles and has additional advantages over other systems which are unable to stand the very trying conditions, and where other cables frequently fail when drawn into underground pipes where moisture and iron oxides are present.

It pays the consumer to specify it, because its life is longer than any other cable, it is easily installed, safe and simple, economical, does not perish, can withstand any rough handling, needs no special fittings, no loose braiding to harbour dust, can be buried in plaster, distempered, papered or painted over to match the colour of the wall or ceiling, saves time, labour, worry and mess and is the ideal cable for all domestic electrical appliances; furthermore, it is cheaper in the long run, neat and unobtrusive, very flexible, can be fixed anywhere where it is convenient without cutting away any part of the house or building, and is less liable to be damaged by careless workmen, and can be handled with confidence without fear of electric shock. One of the main factors in the ideal electric home is C.T.S. cable, which gives the same service of efficiency whether it be for a workman's house or a mansion.

It can be used anywhere to suit any purpose, nothing presenting any difficulty to C.T.S. In iron and steel works it does not get very kindly treated; workmen walk over it or metal falls on it. In chemical works it is lime, alum, caustic soda, acid and fume resisting. For lighting and starting sets for motor-cars it is invaluable, because these are some of the conditions it has to withstand, where other cable would fail: rough mechanical usage, in the form of accidental knocks from tools during adjustment or overhaul;

intense heat where cable is run along the chassis, under the engine bonnet or in the neighbourhood of the exhaust; oil, grease, petrol and water; and abrasion due to vibration. In the boiler-house steam, heat or moisture cannot affect it, and it can be trailed along the ground and withstand any amount of rough usage and hard wear, being unkinkable and electrolysis-proof. In the mine, where cables have to be very safe, owing to the risk to life, C.T.S. cable is used, and there has to withstand very severe tests as to its efficiency. When working conveyors and signals and when lying on pit roadways, working coal-cutters, it is never treated with respect, for it gets trodden on and is pulled along the very uneven surface of the ground a large number of times a day; but that even does not injure it. It is also used with equally good results for portable work, power and lighting in engineering works, soap works, tanneries, paper mills, breweries, pier pavilions and shelters, and similar places subject to sea water and sea air, by climatic or temperate conditions. For tunnel or subway work it offers no difficulties, and it can be used as battery regulating leads, tails for boxes, and dynamo cables. It can also be buried in cement or any kind of earth under all known conditions, and, being non-corrosive, the safety or quality of the cable is not interfered with.

The fact that C.T.S. has stirred up the advantages of electrification of the world shows that the perfect path for electricity has now been found in C—ables T—hat S—atisfy.

The disadvantages of the St. Helens Cable Co.'s patent are very conspicuous by their total absence.

THE USE OF LIGHT IN MODERN ADVERTISING.

The meeting of the Illuminating Engineering Society on March 21 was given up to a discussion on the above subject, papers being read by Miss M. Partridge and Mr. G. P. Garbett.

Miss Partridge, in her introductory remarks, pointed out that, for the majority of shops, a well-dressed and well-lighted window is one of the best and most paying forms of advertising. There is, however, still much difference of opinion as to the best methods, though it is agreed that sources of light should be concealed, and irritating shadows avoided. Miss Partridge quoted three cases illustrating different views put forward. It is easier to say what good lighting is *not*, e.g., it is not a display of electric fittings, nor an ambitious attempt to light the street, nor a collection of half-watt lamps dotted about at eye-level. The amount of illumination, which may vary from ½ to 2 c.p. per cubic foot, depends on the nature of the goods, and also on the amount of light used in neighbouring shops! Much more might be done with the judicious use of colour. Drapers should be urged to use colour-matching lamps.

The latter part of the address was given up to an account of the neon sign, and it was explained how, by adding certain impurities, the colour could be altered from the natural vivid orange to pink, lavender, blue or violet. The very high voltage (up to 15,000 volts or more) requires considerable care, and the erection of the signs on the roofs of houses is often a somewhat difficult problem.

Mr. G. P. Garbett, who followed, traced the early development of the electric sign in the United States, and explained how the dominance of the commercial outlook had led to the installations of continually bigger signs with "punch." In this country, in deference to public opinion, more restrained and artistic methods had been encouraged, and, in fact, the typically British design of the older type compared favourably with anything of a similar character produced abroad.

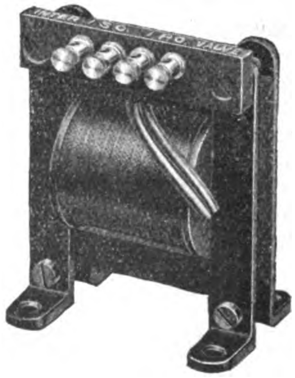
Mr. Garbett showed how the weak features of the original letter-signs had since been avoided and how the modern sheet steel channel section ensured good legibility and enabled a sign to be seen over a wide angle. The most important feature in lamps was not efficiency but durability; the whole character of a letter might be altered by a failure of one or two lamps. Bayonet-holders had proved unsatisfactory for outdoor signs. A description, illustrated by a number of pleasing lantern slides, was next given of various forms of movement. Mr. Garbett also pointed out the harassing nature of some of the complex restrictions imposed by authorities, and the great variety in the requirements in different towns. While it is undoubtedly in the public interest that there should be some control over electric signs, the various conflicting regulations should surely be superseded by a unified set of by-laws. In conclusion, Mr. Garbett remarked that effective electrical displays called for attractive power, legibility and selling power. Electric signs had two main characteristics, brightness and animation, and to these might be added originality, colour, design and position—all factors that required careful attention in the case of an electric sign.

The subsequent discussion, in which several representatives of bodies associated with advertising took part, was enlivened by some pleasing exhibits, including a striking neon sign, and lantern slides showing different types of illuminated windows. One of the most striking of these was the view shown by Mr. T. E. Ritchie of the new lighting of the Army and Navy Stores.

After a vote of thanks had been passed to the authors, it was announced that the next meeting, on April 29, would be devoted to a discussion on "Some Problems in the Lighting of Textile Mills."

THE GECOPHONE LOW-FREQUENCY TRANSFORMERS.

Many of the troubles experienced by amateurs in the construction and manipulation of their sets is due to unsatisfactory or unsuitable low-frequency transformers.



The design of a transformer involves something more than merely winding so many turns of wire on a bobbin. Such considerations as good insulation, the correct proportioning of the iron circuit, and the selection of suitable material for the core should receive careful consideration. In the new Gecophone low-frequency transformer illustrated above, the windings are all of silk-covered wire, carefully wound, and properly insulated so that shorted turns are impossible. The very greatest care is taken in designing the iron circuit, the very best laminated stalloy being used for this purpose. The sections are amply proportioned for the work required so that any increase in current produces a corresponding increase in magnetic flux. The design is such that the transformer is not affected by stray magentic influence, while each transformer is most carefully tested after manufacture on alternating currents of ordinary speech frequencies. Moreover, measurements of the inductance and self-capacity of the winding are taken after manufacture.

PROBLEMS IN TELEPHONY, SOLVED AND UNSOLVED.*

BY PROFESSOR J. A. FLEMING, M.A., D.Sc., F.R.S.

(Continued from page 168.)

IX.—THE PROBLEMS OF COMMERCIAL TELEPHONY.

(18) The great advances in the development of commercial telephony centre round three remarkable groups of inventions connected with the working out of the telephone exchange system. These are (i) the Common Battery System, (ii) the Multiple Switchboard, and (iii) the Automatic Telephone Exchange. The use of the telephone would probably have been comparatively limited if it had not been for the conception of a telephone exchange for mutual conversation. This may be said to have originated with Bell almost immediately after he and others had given us the means of talking along a wire. It was the success which attended even the first crude attempts to establish an exchange system which created the necessity for grappling seriously with the unsolved problems in connection with it. To deal even in the barest outline with the manner in which the problems of exchange telephony have been approached and fairly well solved would require not merely a fragment of a lecture, but a long course of lectures. Moreover, the literature of the subject is extremely extensive. The masterly treatise of our member, Mr. J. E. Kingsbury, on "The Telephone and Telephone Exchanges" (Longmans, Green and Co), covers the broad general history and special treatises, and papers without number supply abundant technical details. Hence I shall not attempt to repeat that which has already been so well said.

The development of the automatic exchange is a story of fascinating interest. It presents us with a galaxy of inventions of astounding ingenuity, the result of which has been to give us a mechanical appliance which is almost a living organism in its capabilities and adaptability to the requirements of human intercourse.

X.—SOME PROBLEMS OF RADIO-TELEPHONY.

(19) The very remarkable progress in radio-telephony during and since the European war has been chiefly due to the wonderful intrinsic powers of the three-electrode thermionic valve, which have been brought to light by the researches and inventions of numerous investigators of the highest ability.

An achievement which a few years ago was the occasional and imperfectly performed feat of experts has now become a popular pastime, with apparatus for it sold in countless shops.

Still there are many problems connected with radiotelegraphy as yet imperfectly solved, although astonishing progress has been made in some respects in the last few years.

Limiting our considerations solely to the subject of speech transmission by radio we find that in the transmitting part of the appliance as generator of the carrier electromagnetic waves required, the thermionic valve has displaced all other rivals such as the arc and high-frequency spark. It is questionable whether high-frequency alternators or Poulsen arcs will survive in competition with the valve. As long as we are concerned only with small-power radiation the glass-bulb high-vacuum three-electrode valve provides a very convenient generating appliance. Assuming that it is not too badly treated during the process of manufacture by the electron bombardment of the metallic parts and consequent wear of the filament, it has a fairly satisfactory life.

Even up to a power of 5 kw. the glass-bulb valve is still a very practical appliance, although silica bulbs have been used for somewhat larger powers. Methods of using a large number of valves of, say, 5-kw. capacity in parallel, have been perfected, as in the large valve panel at Marconi's Wireless Station, Carnarvon, where sixty or more valves of the above size are employed in parallel. For larger powers and in prolonged use the heating of the anodes sometimes gives trouble.

An advance which has been made during the past year is, therefore, the discovery of a method of constructing high-power valves with bulbs partly of metal and partly of glass. The metal part also forms the anode, and can be kept cold by water circulation or air cooling. This new type of valve was rendered possible by the discovery of a method of sealing together a glass and a copper-plated nickel tube. Hitherto it has been necessary to convey the currents into and out of the glass bulb by platinum wires sealed through lead glass. The present high price of platinum (about £23 per ounce) prohibits any extensive use of this metal.

Some years ago Mr. W. G. Housekeeper, of the Bell Research Laboratory of the Western Electric Company, U.S.A., endeavoured to cheapen the production of telephone switchboard incandescent lamps by the use of copper instead of platinum for leading-in wires. Copper is possessed of one of the qualities necessary for an airtight seal through glass, viz., that it is "wetted" by molten glass and adheres to it. Copper and glass have, however, quite different co-efficients of expansion. It has been found that a thin nickel copper-plated tube provided with a knife-edge end can be sealed airtight to a glass tube, and the joint will not crack on cooling or on re-heating. Hence the construction of a metal-glass bulb thermionic valve for large power can be carried out as follows:—

A copper tube 3 or 4 inches or more in diameter, closed at one end, has a copper-plated nickel ring welded to one end which has a sharp bevel at the free edge. This can be sealed on to a glass tube. The copper tube is provided with a jacket, and can be water cooled.

The glass portion has a re-entrant end through which copper leads are sealed to convey the filament heating current and also the connection to the grid, provided it is a three-electrode valve. It will be intense heat where cable is run along the chassis, under the engine bonnet or in the neighbourhood of the exhaust; oil, grease, petrol and water; and abrasion due to vibration. In the boiler-house steam, heat or moisture cannot affect it, and it can be trailed along the ground and withstand any amount of rough usage and hard wear, being unkinkable and electrolysis-proof. In the mine, where cables have to be very safe, owing to the risk to life, C.T.S. cable is used, and there has to withstand very severe tests as to its efficiency. When working conveyors and signals and when lying on pit roadways, working coal-cutters, it is never treated with respect, for it gets trodden on and is pulled along the very uneven surface of the ground a large number of times a day; but that even does not injure it. It is also used with equally good results for portable work, power and lighting in engineering works, soap works, tanneries, paper mills, breweries, pier pavilions and shelters, and similar places subject to sea water and sea air, by climatic or temperate conditions. For tunnel or subway work it offers no difficulties, and it can be used as battery regulating leads, tails for boxes, and dynamo cables. It can also be buried in cement or any kind of earth under all known conditions, and, being non-corrosive, the safety or quality of the cable is not interfered with.

---

*Lecture delivered before the Institution of Electrical Engineers, to whom we are indebted for the illustrations.

The fact that C.T.S. has stirred up the advantages of electrification of the world shows that the perfect path for electricity has now been found in C—ables T—hat S—atisfy.

The disadvantages of the St. Helens Cable Co.'s patent are very conspicuous by their total absence.

THE USE OF LIGHT IN MODERN ADVERTISING.

The meeting of the Illuminating Engineering Society on March 21 was given up to a discussion on the above subject, papers being read by Miss M. Partridge and Mr. G. P. Garbett.

Miss Partridge, in her introductory remarks, pointed out that, for the majority of shops, a well-dressed and well-lighted window is one of the best and most paying forms of advertising. There is, however, still much difference of opinion as to the best methods, though it is agreed that sources of light should be concealed, and irritating shadows avoided. Miss Partridge quoted three cases illustrating different views put forward. It is easier to say what good lighting is *not*, e.g., it is not a display of electric fittings, nor an ambitious attempt to light the street, nor a collection of half-watt lamps dotted about at eye-level. The amount of illumination, which may vary from ½ to 2 c.p. per cubic foot, depends on the nature of the goods, and also on the amount of light used in neighbouring shops! Much more might be done with the judicious use of colour. Drapers should be urged to use colour-matching lamps.

The latter part of the address was given up to an account of the neon sign, and it was explained how, by adding certain impurities, the colour could be altered from the natural vivid orange to pink, lavender, blue or violet. The very high voltage (up to 15,000 volts or more) requires considerable care, and the erection of the signs on the roofs of houses is often a somewhat difficult problem.

Mr. G. P. Garbett, who followed, traced the early development of the electric sign in the United States, and explained how the dominance of the commercial outlook had led to the installations of continually bigger signs with "punch." In this country, in deference to public opinion, more restrained and artistic methods had been encouraged, and, in fact, the typically British design of the older type compared favourably with anything of a similar character produced abroad.

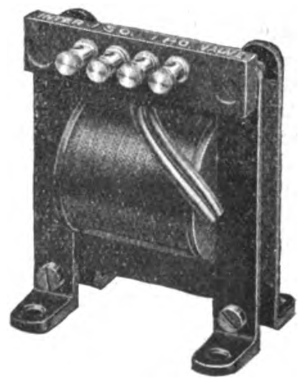
Mr. Garbett showed how the weak features of the original letter-signs had since been avoided and how the modern sheet steel channel section ensured good legibility and enabled a sign to be seen over a wide angle. The most important feature in lamps was not efficiency but durability; the whole character of a letter might be altered by a failure of one or two lamps. Bayonet-holders had proved unsatisfactory for outdoor signs. A description, illustrated by a number of pleasing lantern slides, was next given of various forms of movement. Mr. Garbett also pointed out the harassing nature of some of the complex restrictions imposed by authorities, and the great variety in the requirements in different towns. While it is undoubtedly in the public interest that there should be some control over electric signs, the various conflicting regulations should surely be superseded by a unified set of by-laws. In conclusion, Mr. Garbett remarked that effective electrical displays called for attractive power, legibility and selling power. Electric signs had two main characteristics, brightness and animation, and to these might be added originality, colour, design and position—all factors that required careful attention in the case of an electric sign.

The subsequent discussion, in which several representatives of bodies associated with advertising took part, was enlivened by some pleasing exhibits, including a striking neon sign, and lantern slides showing different types of illuminated windows. One of the most striking of these was the view shown by Mr. T. E. Ritchie of the new lighting of the Army and Navy Stores.

After a vote of thanks had been passed to the authors, it was announced that the next meeting, on April 29, would be devoted to a discussion on "Some Problems in the Lighting of Textile Mills."

THE GECOPHONE LOW-FREQUENCY TRANSFORMERS.

Many of the troubles experienced by amateurs in the construction and manipulation of their sets is due to unsatisfactory or unsuitable low-frequency transformers.



The design of a transformer involves something more than merely winding so many turns of wire on a bobbin. Such considerations as good insulation, the correct proportioning of the iron circuit, and the selection of suitable material for the core should receive careful consideration. In the new Gecophone low-frequency transformer illustrated above, the windings are all of silk-covered wire, carefully wound, and properly insulated so that shorted turns are impossible. The very greatest care is taken in designing the iron circuit, the very best laminated stalloy being used for this purpose. The sections are amply proportioned for the work required so that any increase in current produces a corresponding increase in magnetic flux. The design is such that the transformer is not affected by stray magentic influence, while each transformer is most carefully tested after manufacture on alternating currents of ordinary speech frequencies. Moreover, measurements of the inductance and self-capacity of the winding are taken after manufacture.

PROBLEMS IN TELEPHONY, SOLVED AND UNSOLVED.*

By Professor J. A. Fleming, M.A., D.Sc., F.R.S.

(*Continued from page* 168.)

IX.—The Problems of Commercial Telephony.

(18) The great advances in the development of commercial telephony centre round three remarkable groups of inventions connected with the working out of the telephone exchange system. These are (i) the Common Battery System, (ii) the Multiple Switchboard, and (iii) the Automatic Telephone Exchange. The use of the telephone would probably have been comparatively limited if it had not been for the conception of a telephone exchange for mutual conversation. This may be said to have originated with Bell almost immediately after he and others had given us the means of talking along a wire. It was the success which attended even the first crude attempts to establish an exchange system which created the necessity for grappling seriously with the unsolved problems in connection with it. To deal even in the barest outline with the manner in which the problems of exchange telephony have been approached and fairly well solved would require not merely a fragment of a lecture, but a long course of lectures. Moreover, the literature of the subject is extremely extensive. The masterly treatise of our member, Mr. J. E. Kingsbury, on "The Telephone and Telephone Exchanges" (Longmans, Green and Co), covers the broad general history and special treatises, and papers without number supply abundant technical details. Hence I shall not attempt to repeat that which has already been so well said.

The development of the automatic exchange is a story of fascinating interest. It presents us with a galaxy of inventions of astounding ingenuity, the result of which has been to give us a mechanical appliance which is almost a living organism in its capabilities and adaptability to the requirements of human intercourse.

X.—Some Problems of Radio-Telephony.

(19) The very remarkable progress in radio-telephony during and since the European war has been chiefly due to the wonderful intrinsic powers of the three-electrode thermionic valve, which have been brought to light by the researches and inventions of numerous investigators of the highest ability.

An achievement which a few years ago was the occasional and imperfectly performed feat of experts has now become a popular pastime, with apparatus for it sold in countless shops.

Still there are many problems connected with radiotelegraphy as yet imperfectly solved, although astonishing progress has been made in some respects in the last few years.

Limiting our considerations solely to the subject of speech transmission by radio we find that in the transmitting part of the appliance as generator of the carrier electromagnetic waves required, the thermionic valve has displaced all other rivals such as the arc and high-frequency spark. It is questionable whether high-frequency alternators or Poulsen arcs will survive in competition with the valve. As long as we are concerned only with small-power radiation the glass-bulb high-vacuum three-electrode valve provides a very convenient generating appliance. Assuming that it is not too badly treated during the process of manufacture by the electron bombardment of the metallic parts and consequent wear of the filament, it has a fairly satisfactory life.

Even up to a power of 5 kw. the glass-bulb valve is still a very practical appliance, although silica bulbs have been used for somewhat larger powers. Methods of using a large number of valves of, say, 5-kw. capacity in parallel, have been perfected, as in the large valve panel at Marconi's Wireless Station, Carnarvon, where sixty or more valves of the above size are employed in parallel. For larger powers and in prolonged use the heating of the anodes sometimes gives trouble.

An advance which has been made during the past year is, therefore, the discovery of a method of constructing high-power valves with bulbs partly of metal and partly of glass. The metal part also forms the anode, and can be kept cold by water circulation or air cooling. This new type of valve was rendered possible by the discovery of a method of sealing together a glass and a copper-plated nickel tube. Hitherto it has been necessary to convey the currents into and out of the glass bulb by platinum wires sealed through lead glass. The present high price of platinum (about £23 per ounce) prohibits any extensive use of this metal.

Some years ago Mr. W. G. Housekeeper, of the Bell Research Laboratory of the Western Electric Company, U.S.A., endeavoured to cheapen the production of telephone switchboard incandescent lamps by the use of copper instead of platinum for leading-in wires. Copper is possessed of one of the qualities necessary for an airtight seal through glass, viz.. that it is "wetted" by molten glass and adheres to it. Copper and glass have, however, quite different co-efficients of expansion. It has been found that a thin nickel copper-plated tube provided with a knife-edge end can be sealed airtight to a glass tube, and the joint will not crack on cooling or on re-heating. Hence the construction of a metal-glass bulb thermionic valve for large power can be carried out as follows:—

A copper tube 3 or 4 inches or more in diameter, closed at one end, has a copper-plated nickel ring welded to one end which has a sharp bevel at the free edge. This can be sealed on to a glass tube. The copper tube is provided with a jacket, and can be water cooled.

The glass portion has a re-entrant end through which copper leads are sealed to convey the filament heating current and also the connection to the grid, provided it is a three-electrode valve. It will be remembered that our President, Mr. F. Gill, exhibited some months ago to the Institution some 10-kw. three-electrode valves of this type, made by the Western Electric Company. The filaments of these valves are stout tungsten wires, and take 24.5 amperes at 32 volts to bring them to bright incandesence. The normal plate voltage is 10,000 volts supplied from a D.C. dynamo or by rectified low-frequency alternating voltage. The power intake of the tube, including filament-heating, is 15 kw., and the efficiency 75 per cent. The General Electric Company of America have also been working along the same lines in the development of high-power valves. They have produced a 20-kw. valve, comprising a copper anode tube which forms part of the bulb, and is about 1.9 in. in diameter and 8 in. long. This is sealed to a glass tube 2.75 in. in diameter at the widest part.

---

*Lecture delivered before the Institution of Electrical Engineers, to whom we are indebted for the illustrations.

The filament of this valve is a stout tungsten wire 1.25 in. in diameter, and is heated by a current of 50 amperes supplied at 20 volts. The plate voltage is 15,000 volts, and the overall efficiency of the valve as a generator is about 70 per cent.

A 100-kw. valve of the same type is being developed by the same corporation. I have seen some similar valves of 150-kw. power made by a firm in Holland. An additional advance which may have important consequences in connection with high-power generating valves consists in abolishing the grid and returning to the simple two-electrode or Fleming valve as an oscillation generator on the following principles. If a straight rod, say, of tungsten, is made incandescent in a high vacuum, it emits, as we know, electrons normal to its surface. If the filament is surrounded by a cylindrical anode kept at a high positive potential, these electrons move radially towards the anode, creating a thermionic current. The filament-heating current, however, produces a circular embracing magnetic field, and the moving electrons are therefore acted upon by a force tending to make them move across these lines of force in a direction parallel to the filament, or even bring them back towards it.

If, then, the filament is heated by a high-frequency alternating current, the temperature and, therefore, electronic emission keep nearly constant, but during the instants of maximum filament current there will be a force reducing the thermionic current, which last, however, will rise to its full strength during the instants when the filament-heating current is zero.

Accordingly, if the straight filament of a two-electrode valve with cylindrical anode is heated by a strong high-frequency alternating current, say, of 20,000 p.p.s., and if a high positive voltage is put upon the anode, the thermionic current is an external circuit connecting the anode, and the filament will have pulsations in it having a frequency twice that of the filament-heating current. These pulsations may, by a proper transformer in the external anode circuit, be converted into high-frequency alternating current.

The valve so used becomes a sort of alternating-current transformer or converter of part of the energy of a direct high-voltage current into a high-frequency alternating current. In place of the electrostatic control of the thermionic current by the grid potential we have magnetic control by means of the field, due to the filament-heating current.

(*To be concluded.*)

HEAVY-OIL ENGINE INDICATOR DIAGRAMS.*

At the meeting of the Diesel Engine Users' Assocn., which was held on 28th ult., a paper on this subject was read by Mr. J. M. Ferguson. The author said that there were two fundamental types of indicator diagram, (*a*) the combustion at constant pressure type, as exemplified by the Diesel engine, (*b*) the combustion at constant volume type, as obtained from explosive mixture engines. Neither of these descriptions was strictly accurate, as combustion continued in both long after the constant pressure or constant volume had disappeared. The diagrams from solid injection engines combined both types to some extent, *i.e.*, there was a marked rise in pressure beyond the compression, but the pressure was maintained at the top of the diagram, making it somewhat flattened or rounded in shape.

The colour and beat of the exhaust was a good guide to the running of an engine. The facility with which an engine started, its general running and temperature, the temperature and amount of cooling water, and the temperature of the exhaust were also useful points to note. The real value of indicator diagrams to the engine user was to assist him in diagnosing the cause of any irregularity in the operation of the engine and in ascertaining the correctness of the compression pressure, the maximum pressure and the equal development of power by each cylinder of an engine. Apart from these points the particular shape of the diagram was not of importance provided the exhaust was clear, which meant that the fuel consumption was satisfactory.

The motion for the indicator gear was now commonly taken from the piston or crosshead, so that the movement of the indicator drum synchronised with the piston and the accuracy of the proportional movement might be left to the engine builders. Care should be taken to maintain the gear without slackness at any of the points if accurate diagrams were desired. To obtain reliable results the indicator must be kept clean and cool by removal from the engine, except when diagrams were actually being taken. The use of one indicator on a multi-cylinder engine tended to lead to this desirable state of affairs, and had the advantage that the diagrams were more strictly comparable, as any difference due to the indicator itself was obviated.

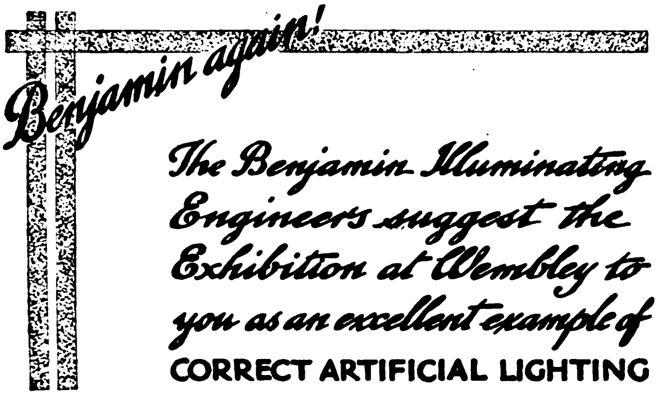
Diagrams could be affected so much by various sources of error that it was futile to ascribe to them an accuracy which they did not possess. When the diagrams were worked out, the manipulation of the planimeter also led to further discrepancies, so that it was quite useless to state the m.e.p. or i.h.p. to a finer figure than was represented by 1 per cent.; in fact, accuracy of this order could only be obtained under special conditions.

Meetings.—The I.E.E. will meet on Thursday, 10th inst., at 6 p.m. Paper: "Power Circuit Interference with Telegraphs and Telephones," by S. C. Bartholomew (Member).

The E.T.B.I.—The annual general meeting of the Electrical Trades Benevolent Institution will be held at the offices of the I.E.E., Savoy Place, London, W.C.2, on Monday, the 7th inst., at 2.30 p.m.

---

* Copies of the paper, which is illustrated by a series of indicator diagrams, together with an account of the discussion thereon, may be obtained from Mr. Percy Still, Joint Hon. Sec. of the Association, at 19, Cadogan Gardens, London, S.W.3.



Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17.

TO OUR READERS.

Electricity is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application.

Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. Rentell and Co., Ltd., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

Obsolescent Tramways.

There seems little doubt that the ultimate outcome of the recent transportation strike in London will be the gradual supersession of the tramway as a means of passenger transport in our larger and more congested cities. For some considerable time past it has been frankly admitted, even by their most ardent supporters, that tramways are doomed from the standpoint of economics. Even under the most favourable conditions they find it very difficult to pay their way, and any service which is not self-supporting cannot hope to survive indefinitely. Unlike most cities, London is in the happy position of enjoying several alternative means of locomotion, but when traffic is at its busiest, all these alternatives are called upon to carry a maximum of passengers. The tubes and the very flexible motor-'bus system have no difficulty in making ends meet, and providing convenient and rapid passenger transport at fares which are within reach of every class of traveller.

The tramways, on the other hand, have long been in a difficult position financially, and in competition with the 'bus services were barely justifying their continued existence before this demand came along for higher wages from the personnel. To subsidise the tramway services at the expense of the 'buses and tubes would be manifestly unjust; each service must bear its own burden, and, if it fail to pay expenses, a good case has been made out for its ultimate supersession by the more modern and efficient services which are running in conjunction with it. There is no necessity to recapitulate the disadvantages and drawbacks under which tramways operate in all large centres of population to-day. They are familiar to everybody. The costly track and its maintenance, the obstruction to other fast traffic, due to the trams having to follow a definite route in the very centre of the roadway; the dangers attendant upon setting down and taking up passengers; the general unwieldiness of the individual vehicles; the inflexibility of the service at rush hours, etc., all militate against adapting this form of transport to modern traffic requirements.

No; the tramway must go, and, in all probability, London will set the example by gradually superseding her present tramway services by motor-'buses and possibly tube extensions in various directions as time goes on. There is no question of a wholesale scrapping of a system which has served us so well for the past quarter of a century; the process will necessarily be gradual; a retirement of derelict vehicles and their substitution by 'buses, followed, in course of time, by the ultimate recovery of the thousands of tons of track when road construction and repairing schemes permit. There is another aspect of the supersession of tramways which has to be considered, and that is the consequent release of large generating units at the principal power stations, at present fully loaded in providing current for the tramways. The gradual lightening of the tramways demand for power would render available for other urgent purposes considerable plant, a factor which should not be lost sight of in view of the ever-growing demand for electrical energy.

Incidentally the recent strike of tramwaymen in London has its parallel both elsewhere in the British Isles and on the Continent, a threatened stoppage of work among the Bolton tramwaymen having been narrowly averted by referring the dispute to the District Joint Industrial Council; whilst in Antwerp, after prolonged and fruitless negotiations, the tramwaymen actually followed the example of the London men and ceased work as an earnest of their demand for higher wages. It is fair to assume that in both cases the situation as between the municipalities concerned and their respective employees is identical with that which obtains in our own Metropolis. The tramway undertakings are only able to carry on by paying wages on the present basis; any appreciable augmentation of the existing rates making just that difference between income and expenditure which would constitute an insupportable drain upon the taxpayers concerned.

These disputes affecting vital public services must necessarily be resolved on an economic basis. The travelling public cannot afford fares above a certain definite figure for a given route or routes; if fares are raised beyond the economic limit, the service is unsupported, and its last state is worse than its first. The revenue of a tramway undertaking is determined by the demand for transportation at popular fares. There is no question of profiteering, the costs are easily ascertained to a fraction of a penny, and the effect of any radical increase in expenditure, necessitated by a demand for increased wages, is obvious immediately it is made. If there were any margin between revenue and expenditure of the average tramway undertaking there might be some other way out of the difficulty which invariably crops up on these occasions; but there is no margin; if any slight difference obtains it is usually on the wrong side, the undertaking continuing to work at a loss as a utilitarian necessity until some more economic substitute can be discovered.

Broadcasting.

Just prior to writing these notes I listened to the opening speeches at the inauguration of the Plymouth relay station of the British Broadcasting Company, and it set me wondering what Drake, Frobisher and the Pilgrim Fathers would have thought of this modern innovation had they come to life again amid their old surroundings. Incidentally, broadcasting is making great headway; the army of critics is increasing, and, from the novelty stage, this form of entertainment has now passed into an era of musical criticism by listeners. In other words, broadcasting has become a recognised form of national entertainment, and a highly convenient means of disseminating important news and extending the scope of public speaking.

Whilst applauding the efforts of the various directors of programmes to educate the public up to a higher appreciation of music, I candidly confess that I am no "high-brow" where music is concerned; possibly I do not possess the true musical ear; the fact remains that some of the modern symphonies and classical compositions appear to me to bear a similar relationship to what has hitherto been classed as "popular" music as does cubist art to the more natural portraying of scenes and portraits on canvas by our leading R.A.s. I thoroughly enjoy the familiar compositions of some of the past masters of musical composition, but I cannot get the hang of what passes for high-class modern composition by our younger composers. I have listened several times lately to "high-brow" classical and symphony concerts, and some of the items appear to be constituted mainly of as many discords as it is possible to crowd into a prolonged orchestral rendering. Although I have persevered, I must frankly confess that they do not appeal to my unmusical ear in the very least. In this connection the innocent criticism of a little visitor rather amused me. I switched on my loud-speaker in the middle of what purported to be a very fine symphony rendered by an orchestra conducted by the composer. After listening for a few minutes, my little niece remarked: "Are they really playing, uncle, or only pretending," a criticism of the entertainment with which, I must confess, I was in full accord.

Emigration.

One of the most important duties we owe our several colonies and dependencies overseas is to send them adequate supplies of young virile manhood and womanhood to populate, and subsequently develop, the many thousands of square miles of rich territory at present lying fallow for lack of the necessary labour and energy. Is it not anomalous that, as rulers of the greatest Empire the world has ever seen, we continue to countenance an over-populated homeland with thousands out of work, crowded cities, housing shortage, and all the other domestic drawbacks to which we have been subject since the war, when overseas there are such magnificent opportunities awaiting the lads and lasses who are not afraid of work, and have the best years of their lives in front of them? There seems to be a lack of the necessary enterprise among our rising generation. Few essay to take the plunge and try their fortunes in the Colonies; yet there are many parts of the Empire which offer far better opportunities to youth in these days than the Old Country can ever give them as stay-at-homes. If I were younger I should not hesitate. You will see some splendid examples of Empire development at Wembley shortly, all achieved by those who took the plunge years ago, and have never lived to regret it. I have never yet come across a true colonial who would care to return to the Old Country for good.

Optimism.

A cheerful and encouraging note was struck by Mr. Longbottom in his address at the luncheon of the B.E.A.M.A. the other day, and he predicts a prosperous 1924 for industry in general and the electrical industry in particular. In the matter of research, Mr. Longbottom pointed to our neglect of this vital factor as exemplified by the fact that engineering development is ahead of the necessary investigations to determine the suitability of materials to fill requirements. In regard to foreign markets, he instanced the beneficent effects upon the industry consequent upon the initiation of important hydro-electric schemes in the Dominions, the progress of railway electrification in South Africa, Japan, Brazil and India, the opening up of new markets in the Baltic States, and the continued activity of the Australian market. Dealing with Imperial preference, he quoted some significant figures, and stressed the growing tendency of foreign countries to become more and more self-supporting in manufactured goods. The foreign trade returns show that in 1913 the Dominions took 46 per cent. of the electrical machinery exported from this country, whereas in 1922 the percentage had risen to 71. In other words, our electrical export market is now almost wholly a Dominion market. The vital importance of encouraging these markets will be obvious to all readers, and Mr. Longbottom referred to the effectiveness of the Wembley display in fostering this trade. We must congratulate him upon a very interesting and encouraging dissertation.

Hostel for Wembley Employees.

A scheme which should prove of direct interest to many of my readers who will be engaged at Wembley during the period of the exhibition, is the transference of what was formerly No. 3 Filling Factory at Park Royal into a giant hostel, to accommodate 3,000 workers. It has been converted into cubicles, single and double, dining halls, recreation rooms, etc., and is being run on a co-operative basis, while trips to various places of historical interest in London and in the surrounding country will be arranged for off-days during the summer. The scheme is being run by an organisation known as the Wembley Visitors' Club, Ltd. The charge for full board in the hostel will be 35s. per week, and it should most certainly help to solve the housing problem for many junior engineers from the midlands and the north. Good luck to it.

Light as an Aid to Advertising.

The use of light in advertising, as illustrated in the luminous sign and the lighted shop window, formed an attractive subject of discussion at the last meeting of the Illuminating Engineering Society. Miss M. Partridge—I believe the first lady who has read a paper before the Society—showed herself quite at home with the subject and gave an arresting account of the problems involved in installing 15,000 volt neon signs on the roofs of buildings. Mr. G. P. Garbett also dealt with modern flashing signs in detail, and showed some very pleasing illustrations of the latest types in London and New York.

A Matter of National Temperament.

Reference was made to the unwieldy, complex and sometimes conflicting requirements imposed by local authorities. While some supervision of signs is needed in the public interest, I agree that these matters might be dealt with in a more expeditious and convenient manner. Perhaps the Illuminating Engineering Society, which represents all aspects, could help in this direction. Both speakers referred to the influence of national temperament on the use of illuminated signs. It is not entirely a matter for regret that our efforts lack the exuberance characteristic of some American cities, and I gladly endorse Mr. Garbett's declaration that the characteristic well-constructed British sign can bear comparison with anything of a similar kind exhibited in other countries.

Pulverised Fuel.

The St. Pancras Electricity and Public Lighting Committee has just recommended the Borough Council to apply for sanction to an additional expenditure of £20,000. This additional expenditure is to provide extra plant which will be suitable for pulverised fuel, and will be part of the boiler-house equipment at their King's Road station. Now the sum of £20,000 is no inconsiderable one, especially when one considers that even now the adoption of pulverised fuel does not meet with unanimous approval. So that the step taken by the authority mentioned is a bold one, and, I do not doubt, a progressive one. It is also worthy of mention that the charge for electric lighting in St. Pancras is only 4½d. per unit, which, in view of so many relatively staggering charges in various parts of the country, is astonishing. Further, this charge of 4½d. per unit is stated to be only one-halfpenny more than the pre-war unit charge.

The use of pulverised fuels so far has merely been in a few isolated cases; some of these have been experimental, and then abandoned. Briefly (though the idea is so simple that the word is hardly necessary), if you wish to burn coal in pulverised—that is, powder—form, you grind it down and then, with a suitable admixture of air, blow it into a modified furnace and (as in the case of the King's Road station) use it for steam-raising purposes. Much experimental work has had to be done to make the system *commercially* workable. One trouble was the enormous amount of fine dust set free from the stacks—naturally, people with a week's washing out drying didn't like it! This can be stopped.

I remember some years ago taking part in a pulverised fuel experiment. Our pulveriser didn't like the job, and broke down with the least compunction—generally a bolt or stone had wandered into the coal. And everywhere in that boiler-house an infinitely fine dust kept falling. You should have seen our lunches when we rashly decided to have them "on the job"! I had to take temperatures inside a chamber where it at times reached 170 deg. F. I didn't linger! Once when I tottered out I was nearly driven mad when a pal, sitting away up on the boiler-top, let fall *some ice cream*, of all things!

Elektron.

THE DAY.

[Kingston Guardians are spending £55 on an electric potato-peeler.—*Evening News*, 13.2.24.*]

We've often thought, the wife an' me,
What sorter Workus we should see
The Day I've wired-up me last job,
'n took me pay from orf "His Nob."

The place *I'd* like 'as spuds at will—
Of pocket snacks I've 'ad my fill.
And surely there'll be plates galore
For a shy or two at the Missus' jore?

The *Missus* dreams, when I retire,
Of household gadgets I can wire;
And so she 'opes to sit an' shirk,
Watchin' the current do the work.

One day I started on me bait,
Cussin' the lad for bein' late,
And on the paper round the pie,
I saw the noos afore your eye.*

When I'd give up stuffin' me face,
I 'ad a think about this place;
A 'lectric peeler for herself!
'Taters on tap to please meself!

That night I laid awake in bed,
The 'tater-peeler in me 'ead.
"The place suits us, there ain't no doubt."
I woke the wife up with a clout.

An' 'avin' told the noos above,
I says, says I: "Teresa, luv,
We'll go an' live down Kingston way,
So's to be ready for The Day."

"George E."

Manchester Wireless Society.—The lecture schedule for March 31 has been postponed until April 15, which will necessitate the general meeting being called later. The experimental transmissions have been highly successful, and several members are to be congratulated on getting down to 185 metres, which was the wave used by 6HG on Sunday, March 23, 2FZ being on 200 metres.

Tenders Accepted.—The Metropolitan Water Board have accepted the tender of the Siemens and English Electric Lamp Co. for the supply of Siemens vacuum lamps for twelve months commencing April 1.——The Islington Borough Council have accepted the tender of the Edison Swan Electric Co., Ltd., for the supply of electrical accessories, conduit, cable, and tinned copper wire.

Questions and Answers by Practical Men.

RULES.

QUESTIONS : *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS : *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to successful replies. The Editor's decision is final.

Commencing with Question No. 101, *a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.*

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 179.

Can any reader give me the technical details of the "Z" connection of instrument transformers used on E.H.T. 3-phase feeder indicator and trip coil circuits? What are the advantages of this type of connection over the ordinary star connection?—" F. B."

(*Replies to Question No.* 179 *must be received not later than April* 26, 1924.)

Answers to Questions.

QUESTION NO. 175.

When working a cinema projector on 200 volts A.C., 50-cycles, using about 15 amperes, with 3-bladed shutter on machine, an intermittent light was produced on the screen. The carbons were burning steadily and not spluttering. By using a single-bladed shutter a good picture was obtained. Can any reader explain this?—" OPERATOR."

REPLIES TO QUESTION NO. 175.

The first prize (10s.) has been awarded to Mr. L. J. Jennings, 210, Cradley Road, Netherton, Dudley, Worcester, for the following reply :—

To answer "Operator's" question, it is necessary to know the principle on which the projection of moving pictures is based.

Simply, it is this: When looking at an object the eyes of a person are not fixed upon it in a continuous stare, but at intervals of a few seconds the eyes blink—that is, the lids close over the eyes and open again. It follows that during the instant that the eyes are closed the person sees nothing of the object and yet has no recollection of *not* having seen it. This is because the shutting and opening of the eyes is so quick that the vision of the object is retained by them during the time they are shut, thus giving the onlooker a continuous vision of the object.

The point to be remembered is this : When the eyes were shut the person saw nothing, but the time was so short that it was not noticed.

Now, as far as "Operator's" arc is concerned, this has nothing to do with his trouble.

A piece of film is made up of a series of entirely separate pictures with a dividing line in between. One picture may be of a man with his hand by his side; the next his hand may be slightly raised, and so on; each picture shows the man in a slightly different position. The film is drawn past the lens of the projector by the sprockets of the machine. The beam of light, of course, passes through the film and lens and projects the picture on to the screen.

Now we come to the object of the shutter. Every time a dividing line of the film comes in the beam of light, the blade of the shutter comes in between the film and the screen. Thus, for the instant that the dividing line is passing the lens the light is shut off from the screen entirely by the shutter. As in the case of the blinking of the eyes, the shutter has passed, and the next picture showing the man in a slightly different position is on the screen before the audience has lost the vision of the last picture. This following up of a series of pictures in quick succession gives the impression of movement by the man on the screen. Yet, if twenty lines have passed the lens, twenty times has the screen been darkened by the shutter.

Now, suppose "Operator" used a single-bladed shutter and set it to such a position that it did not cut the light off the screen when the lines passed the lens. The lines as they passed would then be shown on the screen, but, as the film is moving very quickly, they would appear to be rushing past, and this would give the effect of a flickering light.

The shutter works in conjunction with a Maltese cross which pulls one picture of the film down every quarter of a revolution.

Now, whether it is a one-, two- or three-bladed shutter that is used, it must be set to move in front of the film as the line passes the lens. If it is set a little too soon or too late, every person or object on the screen appears to have white streaks streaming from them either above or below. This is called having a ghost on the picture.

The gearing between the Maltese cross and the spindle holding the shutter decides the number of blades that should be used. For instance, when the cross has made a complete revolution, it has brought four pictures and lines into the light, therefore, the light must be interrupted four times either by a single blade coming round four times, by four blades each of which comes every quarter of a revolution, or by any number of blades that can be arranged by the gearing to obscure and release the light at the proper instant.

If "Operator's" shutter spindle makes four complete revolutions for every one of the Maltese cross, a one-bladed shutter is required. He can set this in position by turning the machine slowly, with the film threaded, and seeing that the blade comes into position at the moment the line passes the lens.

It follows that, if the gearing between cross and spindle brings one blade round at the proper time, as "Operator" says, then the same gearing will not work correctly with three blades.—L. J. JENNINGS.

The second prize (5s.) has been awarded to Mr. T. A. Newton, 13, McAllister Avenue, Airdrie, N.B.

The matter set forth by your correspondent is somewhat difficult to understand, being, as it is, totally opposed to the fundamental principles of shutter design.

The statement, "a good picture was obtained," is rather vague; if this means that the "intermittent light" was less noticeable the matter is more curious. Certainly the substitution of a single-blade wing shutter for the three-wing type will result in a much clearer or brighter picture, but that is an illumination question not under discussion.

Now the function of the revolving shutter on a cinematograph machine bears no relation whatever to the source of illuminant used; its nature, periodicity and pressure, etc., may, therefore, be dismissed as irrelevant. And in passing, be it noted that although it is stated the carbons were burning steadily, etc., A.C. is never the same steady illuminant as D.C.

The actual function of the shutter being to interrupt the light between picture and screen during the transition period of one picture to the next, the film's moving period, there is, therefore, a period of light (exposure) and a period of dark (interruption).

The shutter is so designed to pass maximum light with a minimum amount of flicker (intermittent light).

It should be perfectly obvious that, if the period of light and the period of dark were equal, ideal conditions would obtain, which is approximated by the use of the three-bladed shutter, whose two idle blades interpose during the light period. Using a single-blade shutter the period of light is considerably greater than the period of dark, and the interruption noticed in the form of flicker, more especially at slow speeds; and to obtain the *same* results using the single instead of the three-blade shutter, its speed relative to picture movement must be doubled.

Where a single-blade shutter is substituted a compromise may be effected by speeding up the machine considerably, the flicker would then be less noticeable and a much better light obtained.

This result would probably give the false impression that the substitution gave beneficial results.

Perhaps this is the solution to your correspondent's query.—T. A. Newton.

Reviews of Books, &c.

[*Books noticed in this column will be sent from* Electricity *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.*]

Alternating Currents: Their Theory and Transmission. By E. T. Larner. 198 pp., 107 figs. (Lockwood, 6s. net.)—In this work, which is a new and considerably enlarged edition of a former work published under the title *The Principles of Alternating Currents*, the author presents the theory of alternating currents in a strictly elementary manner to those who are taking up the subject for the first time. The method of treatment adopted appeals to the reader by giving him a good physical conception of the phenomena and characteristics concerned and, at the same time, the formulæ needed for a precise treatment of problems are evolved from first principles. The book thus combines the easy intelligibility of a qualitative treatment with the definition of a numerical treatment. Both of these characteristics are desirable in an elementary exposition, and we have no hesitation in recommending this treatise as a clear and reliable introduction to the theory and practice of alternating currents and A.C. apparatus.

Elementary Electricity. By S. G. Starling. 248 pp., 216 figs. (Longmans, 3s. 6d.)—In this book the author succeeds in presenting a really live and practical introduction to the study of electricity on a basis which shows the student the commercial or applied side of electrical engineerng and, at the same time, instructs him in the basic principles of electrical theory and the relation between electricity and magnetism in accordance with modern concepts. Those branches of magnetism which stand aside from the main treatment of electricity, viz., terrestrial magnetism and the magnetic properties of materials, are relegated to the final chapters instead of being allowed to interrupt the main thread of the book, or to form a more or less irrelevant introduction as was often done in earlier works. The author introduces his subject by dealing with the electric glow-lamp, and from this the rest is developed. In order to establish a wide outlook, chapters on electric waves and wireless telegraphy and telephony, electrons, X-rays and radioactivity are included. Notwithstanding its wide range, the book is coherently written, and we are very favourably impressed by it. It is a mystery how so excellent a treatise can be produced in these days at the low price asked for this volume.

The Dynamo: Vol. II. (Sixth edition.) By C. C. Hawkins. 322 pp., 442 figs. (Pitman, 15s. net.)—This book is already so well known to all the older members of the electrical profession that it will be sufficient for them to know that a new edition (the sixth) has been published; they will at once wish to obtain a copy. For the benefit of the younger members who have not had the advantage of studying the earlier editions, it may be said, without fear of contradiction, that this is undoubtedly one of the best books ever written on the theory, design and manufacture of the dynamo. Also, it has been kept well up-to-date by extensive revision and rewriting.

In the opening chapter of the present volume, which completes the study of continuous-current dynamos, a detailed analysis is given showing the effect of armature reaction on the flux curve under load. Commutation and sparking at the brushes are dealt with very thoroughly, and, notwithstanding the almost universal use of commutating poles at the present day, the author very wisely gives the non-commutating pole machine an important place in this chapter. The full analysis of this machine undoubtedly offers the best means of studying the sparking characteristics of a dynamo and the action of commutating poles. The subject of the eddy loss in solid and in laminated pole pieces has again been reviewed in the light of further experimental results obtained since the previous edition was published. Two designs of dynamos have been worked out in full in order to illustrate the procedure adopted and the use of the various formulæ given in the preceding chapters. The heating of dynamos and the working and management of continuous current dynamos also form the subject matter of valuable chapters.

We are indeed pleased to find this standard work "still running" so lustily.

Up-to-Date Gramophone Tips. By Capt. Barnett, M.I.E.E. Cr. 8vo, 44 pp. (Southsea, Barnett, 1s. net.)—This little book, which has been written by a well known electrical engineer, gives some exceedingly useful and interesting details with regard to the care and maintenance of gramophones, with a view to obtaining the best possible results, and as such it should appeal to a very large number of the readers of this paper. It also includes a short list of favourite records by Compton Mackenzie.

ELECTRIC DAYLIGHT AT THE ZOO.

For the purpose of obtaining daylight effects in the new aquariums under the Mappin Terraces at the Zoological Gardens, Siemens daylight electric lamps have been installed with very successful results. Each of its 95 show-tanks is a beautiful picture, entirely due to the effective lighting, and the varied and picturesque backgrounds modelled by Miss Joan Proctor, F.Z.S. The tanks on the inner side of the gallery are illuminated with Siemens' gasfilled daylight lamps, the glass bulbs of which are selectively tinted so that the light closely approximates actual daylight. This is so effectual that plants and fish flourish as well in it as in natural daylight.

Various Items.

Orders Booked.—The Vickers-Spearing Boiler Co., Ltd., of 20, Kingsway, W.C.2, have during the last two weeks been successful in securing the following contracts for boiler equipment, namely: Aberdeen, two boilers 36,000 lb.; Dover, one boiler 30,000 lb.; Kingston-on-Thames, one boiler 30,000 lb.

Removal.—The J.W.B. Wireless Co., who are the manufacturers of the well-known Brownie Wireless Set, of which many thousands are in use all over the world, state that they have now removed to larger and more commodious premises at 310a-312a, Euston Road, London, N.W.1. 'Phone, Museum 3747.

Quotations Wanted.—The Dept. of Sanitary Works at Buenos Aires invite tenders for the supply and delivery of the electrical machinery required in connection with the water supply works at the town of Santa Rosa de Toay.—Specifications, etc., at the D.O.T. (Room 52), 35, Old Queen Street, S.W.1.

Scottish Agency.—Messrs. William Allan and Co., electric adaptor manufacturers, of 62, Dale Street, Liverpool, have appointed Messrs. W. C. Yuille and Co., of 48, York Street, Glasgow, sole agents for their "Nalla" adaptors for the whole of Scotland. All inquiries in Scotland should be addressed to the above firm.

Motor Shipbuilding Activity.—A considerable degree of activity was shown in the motor shipbuilding industry last month. According to *The Motor Ship*, orders for 11 new cargo vessels, totalling 91,000 tons deadweight, and a passenger liner of some 14,000 tons were placed. The April issue contains also various references to the advantages of electric over steam drive in motor-driven vessels as proved by the experience of the Hamburg-Amerika Line.

Meetings.—An extra meeting of the Inst.C.E. will be held on Tuesday, 8th inst., at 6 p.m., in conjunction with various other institutions, including the I.E.E., when "Standards of Comparison in connection with the Thermal Efficiency of Internal Combustion Engines" will be submitted for discussion by Mr. G. J. Wells.——The Western Centre of the I.E.E. will meet at the Royal Hotel, Plymouth, at 5.45 p.m. on Monday, 7th inst., to hear a lecture by Mr. A. S. Fitzgerald on "The Design of Apparatus for the Protection of Alternating Current Circuits."——A students' meeting of the I.E.E. will be held on Friday, April 11, at 6.30 p.m., when Dr. Alexander Russell, F.R.S., will deliver a presidential address to the students.——The Junior Inst. of Engineers will meet on Friday, 4th inst. Lecturette. "Mineral Oils, with special reference to lubricating and insulating oils," by A. J. Sear, A.R.C.S. Also on Friday, 11th inst. Discussion on paper on "Water Tube Boilers," delivered by L. M. Jeckel, M.I.E.S., A.M.I.Mech.E., on March 14. (Slides.) And on Friday, 25th inst. Lecturette. "Aluminium Electrical Conductors for Overhead Power Transmission," by H. G. Williams (Member). (Slides.) All at 39, Victoria Street, at 7.30 p.m.——The Scottish Centre of the I.E.E. will meet at the Rooms, 207, Bath Street, Glasgow, on Tuesday, 8th inst., at 7.30 p.m. Paper by Prof. W. M. Thornton, O.B.E., D.Sc., on "Some Researches on the Safe Use of Electricity in Coal Mines." On Friday, 25th inst., there will be a meeting at 7.30 p.m. at the Technical Inst., Dundee. Paper by Mr. R. D. Archibald entitled "The Characteristics of a D.C. Series Machine Self-excited by Rectified Current for the Purposes of Regenerative Control."

Sweden.—At present there is in Sweden a very brisk demand for wireless receiving apparatus, and United Kingdom firms desirous of receiving the names of importers of receiving sets should communicate with the D.O.T., 35, Old Queen Street, London, S.W.1.

Electrical Industry in Guatemala.—A confidential report on the general condition of the electrical industry in Guatemala, with notes on the principal electric light and power companies there, has been received in the Department of Overseas Trade from the Acting British Vice-Consul at Guatemala City, and may be consulted at the offices of the D.O.T., 35, Old Queen Street, London, S.W.1, quoting the reference 9,000/F.L./C.C.2.

Trade Notes.

A neat and clear advert. show card has been issued by the **Hart Accumulator Co.** to illustrate their various types of batteries for wireless apparatus, and it should prove of direct value to all retail dealers in radio supplies, to whom it will be willingly sent on application.

A new pamphlet has been issued by **Brittains Electric Motor Co.**, giving clear and detailed specifications of their standard alternating current motors, of single and polyphase types. This motor is so well known on, we might almost say, every alternating current circuit throughout the world, that the pamphlet will be of direct interest to a very large number of our readers.

Pamphlet P. 187, which has been issued by the **British Insulated and Helsby Cables, Ltd.**, of Prescot, gives illustrations and details of the Prescot ceiling fan, which has been designed to meet the demand for a really satisfactory ceiling fan for use in tropical countries. It embodies various novel features by which an unusually high efficiency is attained, and should therefore find a ready market among factors and exporters of electrical goods generally.

List No. 5, just issued by **George Ellison**, of Perry Barr, Birmingham, gives illustrations of the Ellison Plug and Socket Connector for Trailing Cables, which is likely to prove of interest to engineers in factories, mines, docks, etc., where a plug connector for portable tools and machines is a great convenience. The makers claim that it fulfils all the requirements of robust construction, ability to withstand rough usage by unskilled labour, exposure to weather, and to eliminate all the risk of the trailing cable becoming detached from its terminals, at the same time that it makes good electrical contact with the socket, and there is no danger of the contact becoming heated or pitted by sparking under vibration which might possibly be caused by adjacent machinery.

GRINDERS
DRILLS
"DEPENDABLE"
& POLISHING LATHES
MARRYAT & PLACE, ENGINEERS.
28 HATTON GARDEN, E.C.2.

Sample Pair Sent on Approval for 8/6
Made of Pure Para Rubber soft and durable and unaffected by climatic conditions
DAVID MOSELEY & SONS
Limited:
ARDWICK MANCHESTER
MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

APRIL 11, 1924.

CONTENTS. PAGE

Air-Break Control Gear for Small A.C. Motors 185
The "Wembley" Lantern 186
Power Circuit Interference with Telegraphs and Telephones 187
Problems in Telephony, Solved and Unsolved 187
Correspondence 188
Real Help for Exhibitors 188
Current Topics 191
"Tangent" Terminals 192
Economics in Engineering 193
Questions and Answers by Practical Men 193
Fascia Sign Advertising 194
Mineral Lubricating and Insulating Oils 195
Various Items 196

AIR-BREAK CONTROL GEAR FOR SMALL A.C. MOTORS.

GENERAL.

During the early days when electricity was being developed as a commercial proposition, control gear was regarded, and in some cases is even now so regarded, as an unfortunate necessity—a collection of iron, copper and insulation, whose only useful purpose was to connect the motor to the supply mains. No consideration was given to the actual function of the gear, and we had the remarkable spectacle of expensive motors being installed and little or no thought being given to their adequate protection and control. The natural result was that numerous breakdowns occurred, involving extensive losses, until ultimately it was reluctantly conceded that control gear had other and equally necessary uses besides that of connecting the motor to the mains. This is becoming more generally realised every day, but there is room for a considerably greater realisation of this important matter.

BREAKER OR FUSE.

The necessity for protection, particularly against overloads, having become realised, the generally accepted method was to instal fuse equipment consisting of a switch with fuses, suitably rated for the duty they had to perform. Fuses, having a time element of operation, are suitable for motor or similar circuits that are subject to very brief overloads, especially in large factories where expert supervision is possible. In the past few years, however, great progress has been made in the design and manufacture of air-break circuit breakers, and the relative merits of fuses anl circuit breakers has been the cause of much controversy. Present-day circuit breakers are designed for use with automatic overload releases, and by use of suitable time lags the release mechanism can be retarded for any desired period, although at the same time permitting the breaker to open instantaneously on the occurrence of a short circuit.

In considering the pros and cons of each case it is well clearly to bear in mind that the object of both is the same, viz., to provide an efficient means of cutting off the current from the motor or circuit on the occurrence of an overload of any amount, or of any amount greater than a predetermined figure. Consequently, the point to be decided is, which gives the more efficient service. Now, one of the first objections always raised against the circuit breaker is that it is far more expensive than fuse equipment. This undoubtedly is correct, if the initial cost only is considered, but a broader view must be taken for a correct comparison, and the question of maintenance and losses due to idle plant and men must also be considered.

When a circuit is interrupted by a fuse "blowing," considerable time must elapse whilst a skilled man removes the fuse, renews the wire and replaces the fuse before the circuit is available again. On the other hand, if the circuit has been interrupted through the tripping of a circuit breaker, it is only necessary to re-close the breaker (a simple act that can be safely performed by anyone), and the circuit is immediately in operation again. This means that, in a workshop, for instance, where men and machinery would be thrown idle by a failure of the supply, there would be less loss if a circuit breaker controlled the circuit, on account of the shorter time required to make the circuit "alive" again. In a large works this alone means a considerable saving, and would soon account for any difference in the initial cost. It follows, therefore, that where overloads are likely to occur frequently, and the cost of renewing fuses and the expenditure of time involved in replacing them becomes an important consideration, then the overload release fitted to a circuit breaker shows very decided advantages, and it becomes economically preferable to instal such a breaker. Again, for the works where only one motor is used, it is ideal, for its automatic releases can be set to trip at the required amount, and then sealed off so that they cannot be altered by any unauthorised person.

The switch and fuse has its uses, but for the efficient protection and control of motor or similar circuits, and particularly where expert supervision is not possible, it cannot compare with a circuit breaker. Up to a comparatively few years ago a really good breaker did not exist, and there was an excuse for the slavish adherence to the fuse equipment. This, however, does not hold good to-day. The present-day air-break circuit breaker is in most cases a first-class article of robust construction, which can be fitted with reliable protective devices, offering a most efficient means of controlling A.C. motors of small or medium capacities

AIR-BREAK OR OIL-BREAK.

In some quarters there is a tendency to discredit the use of air-break gear on anything but the very smallest of motors, and to urge the adoption of oil-immersed breakers. In most cases this is simply prejudice and lack of thought, for properly designed air-break gear has many advantages over the oil-immersed type. Its initial cost is less, it requires less supervision, is lighter, and more easily inspected. With oil-immersed breakers care has to be taken to see that the oil in the tank always remains at the level intended by the maker, for, if this is neglected or the oil level allowed to fall, the space becomes filled with oil vapour, and the sparking at the contacts may cause a disastrous explosion. The slightest trace of moisture in the oil lowers the insulating capacity enormously, so much so that half of 1 per cent. of water may reduce the dielectric strength as much as 50 per cent. Consequently, the oil in the breaker tanks must be carefully protected, and that required for replacement must always be stored in a dry place in securely plugged drums. Further, the oil in the tank must be changed periodically, a "messy" job that one escaped with air-break gear. In short, air-break gear has most of the advantages of oil-immersed gear, and none of its disadvantages.

Switching "Direct On."

Many supply authorities show great reluctance to allow even medium-size S.C. motors to be thrown direct on to the mains, and in most cases restrict the size of motor to a maximum output of 5 h.p. The reason given for this is that, when the stator of a S.C. motor is connected direct to the line, a very large current is induced in the low-resistance S.C. rotor, and the starting current exceeds many times the normal full load current of the motor. This current lags very much behind the voltage on account of the inductance of the motor, with the result that there is a tendency for the voltage in the adjacent portions of the supply system to be disturbed.

A quarter of a century ago, when power stations and cable ways were small and the lighting load was the chief consideration, it was undoubtedly necessary to prevent "flicker" as motors were started up. Conditions have changed considerably, however, since then, and there seems no logical reason why motors up to at least 10 h.p. or even more should be burdened with a large amount of starting gear of the star-delta, auto-transformer or rheostatic type. If a 150 k.v.a. transformer can be switched on to the line without a "charging" device, there appears to be little reason for using a starter to connect even a 10 or 15 h.p. motor to the transformer secondary. Further, the restrictions are not even consistent, for it is a common occurrence to find an electric arc furnace, which is a very varying load, operating in a works where a 10 h.p. S.C. motor is absolutely forbidden.

The objection that switching motors direct on to the lines carries the risk of blowing service fuses, with considerable loss of time while the fuses are being replaced, does not hold to-day, for this risk can be obviated by the use of suitable gear. Reliable circuit breakers are available which can be safely used by the most unskilled operator and on which the time element can be adjusted with far greater accuracy than is possible with fuses. These breakers can, and should, be used in every possible case for starting single motors and so simplifying the apparatus required.

(*To be continued.*)

A new catalogue dealing with the Wild-Barfield Automatic Electric Hardening Furnaces has just been issued by the **Automatic and Electric Furnaces, Ltd.**, of 175, Farringdon Road, London, E.C.1. It gives clear details, illustrations and diagrams of the latest types of these well-known furnaces, which have built up such a splendid reputation for efficiency during the last few years. The best proof we can quote in this connection is the statement that "what is known with *absolute certainty* is that the steel when withdrawn has attained exactly the right condition and has not gone one iota beyond it. This result can be obtained every time." The users of the furnaces, including the British Admiralty, have verified the results which are claimed for them.

THE "WEMBLEY" LANTERN.

The General Electric Co., Ltd., has recently secured an order from the Charing Cross E.S. Co., Ltd., to supply lanterns and Osram gasfilled lamps for the street lighting of the Charing Cross area, and as this comprises some of the most important thoroughfares and traffic junctions in the world, we think an illustration and description of the lantern which has been selected will interest many of our readers, it being the result of exhaustive experiments undertaken by the company by which they claim to have developed a type nearer to the ideal than anything hitherto available.

They have called it the "Wembley" lantern, and its general appearance is, as will be seen by reference to the illustration, extremely pleasing, whilst the features of outstanding interest are:—

(1) The patented ventilating device, operating upon the ejector principle, and combining to an unusual degree both simplicity and efficiency.

(2) An extremely ingenious focussing device in which, by the half-turn of a screw located upon the exterior of the lantern, the lamp can instantly be adjusted to any desired position.

(3) Terminals of special construction, which for quality of insulation, ease of connection and disconnection and reliability of contact leave little or nothing to be desired.

Stringent tests were made to prove the extraordinarily efficient nature of the ventilation and air circulation provided, the lanterns being subjected for long periods to conditions analogous to those experienced under very heavy rain propelled by a driving wind of hurricane force, and notwithstanding that the conditions produced were such as to exceed in severity anything remotely likely to be experienced in practice, and that they were maintained for periods of 24 hours at a time, no trace of water was found in the interior of any of the lanterns, nor were any lamp failures experienced other than those due to the expiration of the normal lamp life. What is more, although it was not possible to produce artificial snow for testing purposes, the whole of the lanterns at present in service passed through the severe snowstorms of January without the slightest trouble being experienced due to surface leakage across the terminals or the entrance of moisture to the interior.

POWER CIRCUIT INTERFERENCE WITH TELEGRAPHS AND TELEPHONES.*

By S. C. BARTHOLOMEW (MEMBER).

According to the author, this subject is of interest to the designer, the power engineer and the communication engineer, and (in his opinion) the time appears to be ripe for a review of the situation. The paper is a general survey of the position, describing the features in the modern generation and distribution of electrical energy which are responsible for interference with telegraph and telephone circuits, emphasising the importance of harmonics in this connection, and indicating some known remedies which may be applied to power plant at its source when trouble is experienced.

The improvements to be expected by the transposition of wires forming overhead power and telephone circuits are described, and also the practical applications. The separating distance and length where power lines and communication circuits run parallel are next considered with reference to inductive effects from (*a*) the balanced voltages and currents, (*b*) the residual voltages and currents, and (*c*) the abnormal occurrences due to short-circuits, etc.

The balance of telephone circuits is then dealt with. Telephone circuits in this country are designed to be free from disturbance from telegraph circuits and telephone circuits carried on the same routes. It is considered that a balance which will ensure this is the most that can be expected in such a system as a public telephone service, and, if disturbance from power circuits is experienced with such balanced conditions on the telephone circuits, then the injurious affection is excessive. Remedies which may be applied to telephone and telegraph circuits are described.

Reviews of the problem and general experience in this country are then given under the headings of tramways, railways (direct-current and single-phase), and electric light and power systems, with an account of certain remedies and a discussion of the lay-out of power systems as influencing interference. In the author's opinion the solution of the inductive problem is mainly one for the designer; the power engineer, the telephone engineer and the protective-gear engineer are also concerned in that order.

In an appendix Prof. E. W. Marchant describes a method of removing ripples from mercury-arc rectifiers.

Catalogue 52, just published by **A. H. Hunt, Ltd.**, of Tunstall Road, Croydon, is a well-printed book of 48 pp. containing numerous illustrations as well as clear details and prices of the various batteries, cycle lighting sets, wireless goods and other apparatus for which Messrs. Hunt have now built up such a high reputation. The list should therefore be of direct interest to a very large circle of retail dealers and traders, to whom it will be sent post free on application.

PROBLEMS IN TELEPHONY, SOLVED AND UNSOLVED.*

By PROFESSOR J. A. FLEMING, M.A., D.Sc., F.R.S.

(*Concluded from page* 176.)

XI.—CONCLUSION.

(21) A brief reference may be made in conclusion to the position of research on telephonic problems in Great Britain.

The great technical corporations in the United States, such as the American Telephone and Telegraph Company, the Western Electric Company and the General Electric Company, maintain research staffs and laboratories for this purpose with equipments which, as far as I know, have few equivalents in this country. They retain the services of scientific investigators of the highest ability, who direct their attention not exclusively to problems of immediate commercial advantage, but look far ahead into the possible requirements of the future. The only research establishments we in Great Britain possess which are on a par with those of America are the new and finely equipped laboratories of the General Electric Company at North Wembley, the National Physical Laboratory at Teddington, and, on a smaller scale, the British Post Office Research Laboratory at Dollis Hill. There is, however, in Great Britain too much tendency to demand an immediate commercial return, or, at any rate, a very close connection between the character of the research work done and its industrial applications, and also to consider that it can be fostered by small-scale expenditure on scholarships or committees, or usefully conducted by men of mediocre power. The first essential is to find the men with great initiative and original power, and then to place at their disposal adequate resources for research.

It is a lamentable thing, for example, that low-temperature research, of which the foundations were laid at the Royal Institution of Great Britain twenty or thirty years ago (when the late Sir James Dewar first liquified oxygen, air and hydrogen in bulk in open vacuum vessels), practically ceased after the war for want of financial support; whereas it is still active in other countries, such as Canada and Holland. Telegraphy and telephony being under Government control in this country, there is less inducement for private investigators of high ability to make it the subject of their labours. There is not, as far as I am aware, a single university in this country which possesses in its electrical engineering departments the necessary equipment for conducting advanced experimental investigations in telephony and telegraphy.

Nevertheless, research in this subject is a matter of national importance, especially to Great Britain with an Empire scattered over many seas.

We have never been deficient in the possession of men of the highest scientific originality in this country, but the pioneer work of such great investigators as D. E. Hughes, Oliver Heaviside, the late Lord Rayleigh, and even that of Lord Kelvin himself, was not at the time of its performance estimated at its true value, or followed up with sufficient resources in the field of large-scale experiment, with the result that much of its practical outcome has reached us from other countries than our own. The unsolved problems in telephony are still many and of absorbing interest, and it is desirable that the attack on them should be from many sides, and not limited to the personnel of Government laboratories or to the official initiative of small Government committees, but that facilities should exist for bringing to bear upon them the highest theoretical knowledge and most copious experimental skill wherever found. These two rarely united kinds of ability were combined together in a surpassing degree in Lord Kelvin, and we cannot afford to allow the country which gave birth to him to fall behind in the effort to advance our knowledge of electric and magnetic phenomena, especially in relation to the arts of telephony and telegraphy, which have become of such supreme importance in relation to the intercourse of all mankind.

---

* Summary of paper read before the I.E.E.

*Lecture delivered before the Institution of Electrical Engineers, to whom we are indebted for the illustrations.

Correspondence.

re LATE TRAFFIC DISPUTE.

To the Editor of Electricity.

Sir,—Now the tramway strike is settled it would be well to draw the attention of the public to the part the Electrical Trades Union played in the settlement. Once again, however, the scare Press told the people of London that the E.T.U. were going to put London in darkness. Once again, too, the Electrical Power Engineers' Association—brave men!—rushed in to assure, or reassure, the long-suffering public that though the heavens might fall, and darkness reign supreme, they, the E.P.E.A., would act their usual trade-union part. This, too, without making any inquiry as to whether the scare Press were telling the truth or not. Really, Mr. Jones, we are still on the telephone.

My Station Engineers' Committee, at their weekly meeting on Monday, March 24, instructed me to convene by telegram a special meeting in the event of—

(*a*) Any attempt being made to run a scab tram service; or

(*b*) Any extension of the dispute to the tube railways;

and the reason is fairly obvious. If either of these two things happened, our members would have been called upon to generate and distribute "juice" for blacklegs to use, and the E.T.U. is, above anything else, a trade union.

On Wednesday morning the papers conveyed the information that the A.S.L.E. and F. had instructed their members on the tube railways of London to cease work at 12 midnight on Friday, March 28, and on inquiry this was confirmed by that society's assistant general secretary, Mr. Moore. As a result, the special meeting of my committee was held that evening, and a deputation from that meeting was appointed to wait on the Prime Minister the next morning.

The deputation, which consisted of four responsible station men and myself, saw the Prime Minister, Mr. Arthur Henderson, and Mr. Tom Shaw the next morning, and urged them to do their utmost to bring the dispute to an end, with justice to the tram men, before the dispute was extended to the railways. No threat was made in respect to the lights of London, but, of course, the grave position was pointed out to the Prime Minister and his colleagues, and it was very largely as a result of our deputation the conferences, which took place that night and did ultimately end in the settlement of the dispute, were convened. I impressed upon my colleagues the danger of saying anything to any of the Press representatives who crowded round, and no statement of any character was given. This is borne out by the London evening papers of Thursday, March 27, and the *Evening Standard* referred to the conference as the "mystery meeting" with the electricians, who refused to give any statement.

Your readers can therefore imagine how I felt when I saw Friday's papers and found that the E.T.U. once again "topped the bill"; but, believe me, it is getting a bit painful to find that whenever there is a dispute in being, then the good old E.T.U. is going to "dowse the glim." It does seem that whenever we appear on the scene the Press gentlemen run off to the nearest telephone box, and the "London in darkness" automatically follows. Such is fame, and although neither my committee nor myself object to the free advert. given to the Electrical Trades Union, which is, by the way, a real trade union, we certainly think this "darkness" stunt is a bit overdone, and would certainly suggest to your young men that in future they should view Labour troubles, in which the E.T.U. are involved, from a "lighter" standpoint.

There is, too, the danger from our side of the hedge. In my schoolboy days (unfortunately far distant) I read a "wolf" yarn.—Yours faithfully,

W. J. Webb.

London District Secretary, Electrical Trades Union.

April 4, 1924.

REAL HELP FOR EXHIBITORS.

The Association of British Exhibitors is at the present time organising at its headquarters at 36, Victoria Street, S.W., a separate intelligence bureau for the purpose of supplying its members with details about exhibition matters, and in particular with details concerning the efficiency and possibilities of exhibitions about to be promoted.

Nothing could be of greater assistance to stallholders than a bureau of this kind. It will do more than anything else to eliminate the element of chance so often prevalent in exhibitions.

The lighting of the new Tivoli has afforded the **General Electric Co**. an opportunity of issuing a really beautifully printed brochure which illustrates in the highest style of colour printing the achievements of its illuminating engineering department in conjunction with Mr. Bertie Crewe, the principal architect of the Tivoli Cinema. The illustrations show the night lighting of the façade, the fixtures which are used in connection with the work, and also the illumination of the ceiling, the corridors, and of the auditorium generally. It is one of the best pieces of art printing which it has been our pleasure to handle for a very long time.

Catalogue No. 67, relating to shades, bowls and reflectors, has been issued by the **Siemens and English Electric Lamp Co., Ltd.**, of 38/9, Upper Thames Street, E.C.4 It gives illustrations of a wide range of glass, alabaster, silk and other shades, as well as an interesting series of diagrams showing the correct method of illumination and a page of fittings and accessories suitable for use with the bowls and shades which are described. The list should appeal to all installation contractors and illuminating engineers.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of
CORRECT ARTIFICIAL LIGHTING

Advert of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application, Subscription : 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

Unrest.

The present behaviour of certain sections of Labour makes one ashamed of one's nationality. This is a season of epidemics, born for the greater part of the continuous easterly winds; but by far the worst epidemic of them all is that which affects the sound common-sense outlook upon life of the British artisan, earning his daily bread under the ægis of a Government of his fellows. The strike fever is in the blood of the wage-earning community, and it is spread and cultivated by a sprinkling of paid agitators, who derive their income from fomenting discord whenever and wherever working men are gathered together to perform certain essential tasks. The pity of it is that such a large and ordinarily intelligent section of our British public should suffer themselves to be influenced by the oily, specious arguments of these Moscow immigrants.

Take the case of the Wembley fiasco the other day. An agitator, whose sole attributes consisted of a raucous voice and a megaphone to amplify it, was able to bring about a general cessation of work throughout this vast scheme, which was finding much-needed employment for thousands of wage-earners. What is the primary object of the British Empire Exhibition? Obviously to foster a spirit of camaraderie between the homeland and the Dominions overseas; to show our many visitors from various parts of the Empire what British labour can produce, and generally to promote British trade, which, in the end, means more employment and fewer doles. Yet the British workmen employed in finishing that Empire shop window, as it has been aptly termed, lend an immediate ear to the first glib-tongued trouble-monger who comes along, instead of using the brain which a beneficent Nature provided them with at birth.

It grieves me to reflect that representatives of our very own industry set the example a few days beforehand. Certain members of the E.T.U., of a firebrand order, ceased work with a grievance, and, when that was redressed, immediately sought for and discovered another reason why they should not continue to carry out the essential wiring on the Exhibition premises. All are back at work again as I write, but who knows whether some fresh Bolshevik visitor may not come along within the next few days and play upon the vivid imaginations of these thousands of otherwise intelligent workers? I note that the police conducted the Moscow gentleman outside the gates and left him there; but why stop at that? Surely the proper and only place for such gentry is on the deck of a departing vessel at the nearest port, with fair warning never to return to the land of his adoption. We are far too kind to these Red emissaries, especially having regard to the sheep-like obedience of British wage-earners.

What I find so difficult to understand about these recurrent labour agitations is that the British artisan, tackled individually, hates strikes and all that they involve; he is in the main a satisfied and hard-working chap, and, if let well alone to carry out his job, would live and die a perfectly happy and contented individual. I speak with conviction, for I have worked with and lived among British workmen of all grades for very many years, and I have had many conversations with them, at such times as the present, on the subject of labour disputes, both constitutional and irregular, such as is the order of things to-day. Let the British artisan alone and there is no better or more honest worker on the face of the earth; but throw in a leaven of Communists, Reds and paid agitators, and the mischief is done.

In view of the obvious susceptibility of the bulk of our working population to advice, freely bestowed, it would appear essential to counteract the evil done by itinerant hot-air merchants of the Moscow brand by an organised campaign of speeches from the other side. It behoves employers and administrators to evince a closer interest in this matter, mingle more freely with their workers, both during and out of working hours, and preach the far healthier gospel of concentration on the work in hand. The brain of the manual worker is fertile ground, or the insidious preaching of the Communist and red-flag brandisher would not find root and produce such a universal spirit of discontent. That same brain should be equally susceptible to the more considered teachings of those who have the best interests of the Empire at heart.

The average employer is as a rule too fully occupied to devote the necessary time and energy to such a campaign, but there must be many capable speakers on the staffs of most large industrial undertakings who could undertake this task of nullifying the evil wrought by agitators in our midst. The man who works with his hands all day and every day has plenty of time for reflection on the pros and cons of his industrial existence, and is intelligent enough to appreciate the difference between the real and the ideal as represented by modern economic conditions and the Utopia depicted by the paid agitator. We need an effective counter-organisation of the kind I have referred to which, by sane and appropriate propaganda among the mass of workers, could in a very short time nullify the harmful effects of Red precepts.

In this connection much might be accomplished with the aid of broadcasting. Many thousands of working men have receiving sets nowadays, and a series of ten-minute talks on the economics of various industries, couched in simple language which could be at once appreciated by listeners, could not fail to do good. Suppose, for example, that just prior to the advent of the Moscow gentleman with the megaphone among the various Wembley buildings, a five-minutes' talk on the objects of this great Empire display and its ultimate effect upon employment in this country had been broadcast with the aid of loud-speakers, is it conceivable that the argument of the half-brick would have borne fruit as it did. Personally, I think the loud-speakers would have won the day, and the Moscow gentleman have been politely advised to journey as rapidly as possible to that region which he will eventually reach if he persists in his present campaign of fomenting trouble.

China Considers Automatic Phones.

I note that in an interview a prominent official of the Shanghai Mutual Telephone Company informed a journalist that his company was seriously considering the introduction of automatic telephones into Shanghai if climatic conditions permitted. No doubt this decision is influenced by the recent declared policy of the British Post Office to instal Strowger automatics in Greater London, as well as by the fact that automatic telephones solve the language problem, and obviate the necessity for linguist operators at the exchanges. As regards climate and its effects the Shanghai officials need have no qualms, for Strowger equipment has been in successful operation for many years past in equally humid climates to that which prevails in Shanghai. The visitor will have an excellent opportunity of viewing the standard Strowger equipment for London at Wembley, where it will be on view, both in the British Government Pavilion and in the Palace of Engineering.

Whilst on the subject of automatic phones, there is another little matter which requires explanation to the uninitiated. It is claimed for certain installations that "when completed" they will be the "largest yet." Now, although a certain threadbare publicity attaches to so-called "record" installations, it is not a form of publicity which can appropriately be applied to telephone installations, for the simple reason that they are invariably compared in terms of their "present capacity," and not by their "ultimate," which may be anything and has no definite limit. For example, the contemplated 50,000 lines of Strowger equipment for London may, in ten or fifteen years' time, be doubled or even trebled, and the 700 line P.A.X. at the County Hall, Westminster, grow to 1,000 or 1,500 lines within a similar term of years. It cannot be too generally known that there is "no limit" to the growth of any Strowger automatic telephone installation.

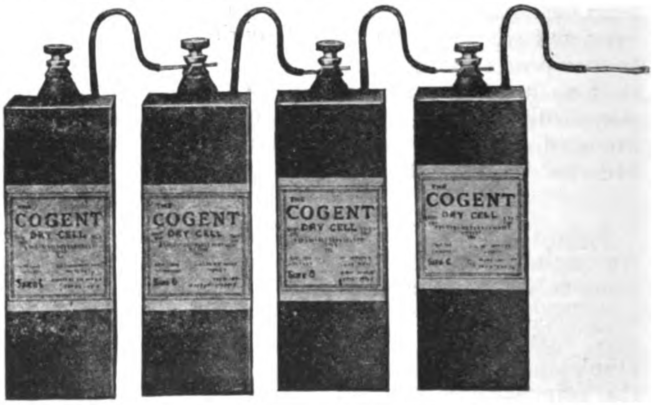
E.T.B.I.

I was present the other day at the annual meeting of the Electrical Trades Benevolent Institution, when the report of the committee, together with the accounts for the year 1923, were duly presented and adopted. The net result shown is that a further £2,932 has been invested, bringing the total funds to £21,732, with a market value of £21,744 on December 31 last. Of course, that is all very satisfactory so far as it goes, but it does not go nearly far enough, and the electrical industry as such ought to blush for shame at the figures when we consider the enormous field which it covers and the thousands who are engaged in it. We must bear in mind that as the trade grows older the number of calls on the fund is likely to increase very materially, but there will be a very poor look out for those who fall on bad times if they do not now use their own exertions to push this most deserving institution, and the best way to prove their enthusiasm is by joining it as members and inducing others who are eligible to do likewise.

After the balance sheet had been approved and passed, various retiring members of the committee were re-elected and the subject of filling the remaining vacancies with lady members was discussed, and ultimately referred back for further consideration Various votes of thanks then concluded the meeting, including a very hearty vote to Mr. F. B. O. Hawes, the hon. secretary, for the painstaking and untiring way in which he had carried out his duties for so many years past.

Elektron.

"TANGENT" TERMINALS.



In our issue of December 28 last we gave an illustrated description of this new terminal, which has been placed on the market by Messrs. Gent and Co., Ltd., of Leicester, and we now reproduce an illustration showing its application to dry cells. Probably many hundreds of our readers are only too well acquainted with the difficulty which is often met with, of connecting up a battery of dry cells when fixed in a position which is not easily accessible, and the frequency with which the wire is pushed out when tightening up the ordinary terminal nut on the carbon electrode, a mishap which may pass unnoticed at the time and leads to much repetition work and waste of valuable minutes. Messrs. Gent claim that this trouble is obviated when these Tangent terminals are used because the tightening of the nut automatically grips and locks the wire at the same time that it makes a perfect contact, and thereby enhances the current value of the cells.

ECONOMICS IN ENGINEERING.

At the meeting of the Informal Section of the I.E.E., held on Monday, the 31st ult., Mr. F. Pooley was in the chair, when Mr. F. Gill opened a discussion on this subject.

Mr. Gill said he felt inclined to apologise for speaking on a subject which is so hackneyed and obvious, and yet so necessary. He picked holes in the dictionary definitions of the term "Engineer" and in the usual methods of teaching economics. He spoke of the dearth of literature dealing with engineering economics, and asked for references to books on the subject which treat economics as the law of returns to expenditure, and as the selection of designs by means of financial considerations. Mr. Gill believes that engineering has given a new meaning to economics, and that the engineer's job is to take up the education of the non-technical business man on financial matters as regards plant, for the engineer alone stands between him and bankruptcy.

He set out the lines upon which engineering projects should be formulated: consideration of the bare requirements and the design of alternatives each of which will meet these requirements; consideration of costs, such as first cost and annual cost, involving questions of credit; also, consideration of depreciation, and provisions for dealing with this problem.

Mr. Gill had prepared some charts and tables for the lantern screen, showing some astonishing comparisons of first-cost maintenance and scrap-value of alternative cable systems. He also showed some notable differences in the Inland Revenue allowances for depreciation of plant in Great Britain, U.S.A. and Germany. Fireproof buildings, furniture and patterns have no allowance for depreciation in Great Britain, and Mr. Gill feels that engineers must combine to instruct the Revenue authorities on these matters.

Mr. Gill is lucid on any subject that he can be induced to speak upon, but the finance of engineering projects is undoubtedly a favourite study with him, and his opening remarks were of absorbing interest.

Mr. D. J. Bolton said that the crux of the matter is that fullest consideration should be given to the point of view of the user who is interested in the economics of the *service*, and not that of the apparatus. The engineer, in stating his case, should proffer better, cheaper, fuller or longer service, rather than dwell on the mere comparison of designs. Mr. B. O. Anson thought economics fail at critical times, when comparisons are not possible. The superiority of Stephenson's steam locomotive to the coach, and the advantages of Arkwright and Hargreaves' spinning machines to the "bobbing wheel," could not be proved except by actual demonstration. Mr. Gill pointed out, however, that it was not economics that failed here, but human knowledge.

Mr. H. Brown spoke of the difficulty of deciding what is maintenance and what is replacement. The sinking fund provision for depreciation is satisfactory if a change of tenure is not likely to arise.

Messrs. C. S. Byng, W. Day, P. Dunsheath, O.B.E., P. Good, L. M. Jockel, S. W. Pook, W. E. Rogers, H. M. Sayers and F. Tremain also spoke.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION No. 179.

Can any reader give me the technical details of the "Z" connection of instrument transformers used on E.H.T. 3-phase feeder indicator and trip coil circuits? What are the advantages of this type of connection over the ordinary star connection?—"F. B."

(*Replies to Question No. 179 must be received not later than April 26, 1924.*)

Answers to Questions.

QUESTION No. 176.

I have a foot-candle meter and the battery is run down, and, I am told, the meter will require recalibrating. Is this so, and, if it is so, how can I calibrate it?—"ILLUMINATOR."

REPLIES TO QUESTION No. 176.

The first prize (10s.) has been awarded to "F.P.S." for the following reply:—

The foot-candle meter is an instrument involving a standard lamp, and is therefore dependent on the lamp being maintained at the correct voltage. It would, therefore, appear that a voltmeter and an adjustable resistance are essential parts of the apparatus, and for some time there was much controversy over this point, but the makers have been able to prove the case for the omission of the voltmeter. This, of course, assuming that reasonable precautions are taken when using the instrument for practical commercial determinations of illumination. It may be added that for really accurate work the omission of the voltmeter would be unthinkable. The dispensing with the voltmeter is only possible on the assumption that the voltage of the battery is practically constant for a certain time, and this is true for the lead accumulator for some time after a charge provided that the peak of the charge has been taken off by a very short discharge. In the case of dry batteries the voltage will remain constant for some time provided that the capacity of the cell is sufficiently large and that the periods of use are short.

From what has been said above it will be clear that the recharging or renewal of the battery will have a marked effect on the calibration of the instrument unless the above conditions are complied with.

Owing to the ageing of the lamp and other causes, a calibration is necessary from time to time, and if one has been decided on it is best carried out at the National Physical Laboratory or by the makers of the instrument. It is, however, possible for the user to do this from time to time if only approximate commercial accuracy is required.

For this it is necessary to have some form of standard source of light. That adopted in standardising laboratories is the pentane lamp, but for the actual comparisons an electric sub-standard is used. This is an electric lamp that has been measured against the pentane standard. A lamp can be obtained with the candle-power determined from the N.P.L. or another calibrating laboratory, or, failing this, a standard candle can be purchased.

If an electric supply is available, together with a voltmeter and a rheostat, it would be well to get one of the electric lamps calibrated as above mentioned at a voltage, say, 10 per cent. below that of the supply, to allow a margin for regulation.

The following tests must be made in a dark-room where there is no chance of reflection, or if a suitable dark-room is not available it is well to do the calibration in the open on a black night. It must be borne in mind that in rooms the reflection may increase the light directly received by 200 per cent.

A dead white screen is then set up at a distance of 3 ft. from the standard, and the illumination of its surface measured by the instrument that is under calibration. For example, if the candle-power of the standard lamp is 17.4 the illumination of the screen would be $17.4/3^2 = 1.71$ ft. candles.

The reading of the instrument was found to be 1.95, being too high by 0.24, or giving a correction factor of $1.71/1.95 = 0.88$, which corresponds to a correction of 12.3 per cent. on the readings.

The power of lamps is now generally given in lumens or spherical candle-power, and while this is the correct thing it is not convenient for the present purpose, and the lamps to be used as standards should have the candle-power stated in a definite direction, or failing that the mean horizontal candle-power should be specified. In the latter case it would be necessary to measure the illumination of the screen in, say, sixteen different positions of the lamp, each being an equal angular displacement. The mean of these readings is taken to give the reading of the instrument that corresponds with the specified mean horizontal candle-power of the lamp. Another method that saves much time and trouble in this case is to keep the lamp revolving, but it is unlikely that suitable gear is available.

In the event of an electric supply not being available recourse will probably be had to a standard candle, in which case the distance of the source, that is the candle, should be reduced to 1 ft., owing to the lower candle-power.

It may be added that without the most precise instruments and precautions taken by able and experienced men, good results cannot be expected, as the sources of error are boundless.—" F. P. S."

The second prize (5s.) has been awarded to " M. M." for the following reply :—

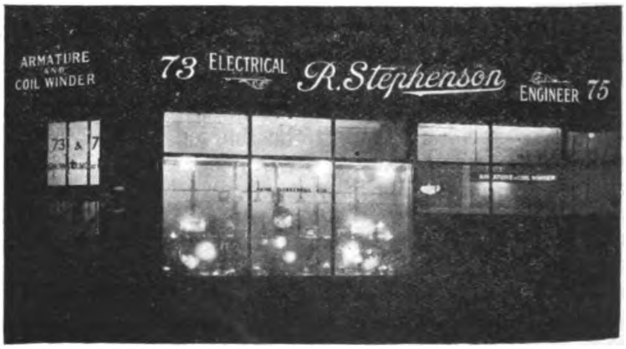
Photometry is a very complicated science and a number of difficult measurements have to be made if accurate figures are required. Even with the same apparatus and under the same conditions, two operators will frequently obtain very different results.

By means of photometers the illuminating power of the source to be measured is compared with that given by a " standard." It will therefore be evident that the standard employed should be as nearly accurate as possible. The battery in the instrument possessed by " Illuminator " is probably a combination of two lead-acid secondary cells, intended to supply current at four volts. To ensure that the voltage is satisfactory a voltmeter should be employed. Just after being charged the voltage may exceed four, on the other hand, after working for a time, the voltage may be below normal. This is a very important point, as the illuminating power of an incandescent lamp varies, approximately, as the fourth power of the applied voltage. The scale on the instrument, by which the illumination is indicated, should be examined to see that it is working properly. A rough idea could be obtained as to the condition of the instrument by means of a " standard " candle, but unfortunately these candles are said to vary as much as 20 per cent. If a standard incandescent lamp could be obtained, by taking a number of readings it would be possible to put the photometer in a fairly reliable condition.

If accurate figures are required it would certainly be the best policy to return the instrument to the makers for overhaul and recalibration.—" M. M."

FASCIA SIGN ADVERTISING.

An innovation in illuminated fascias is illustrated below. This excellent position over shops and other business premises is, as a rule, dead at night, whereas by this method universal attention is drawn to the name and the business carried on long after the premises are closed. The fascia wording is thrown into bold relief at dusk by a method of reflected light, giving, as the photograph shows, a perfectly even and shadowless light distribution, enabling the lettering to be read from a considerable distance.



The fascia is of polished oak 27 ft. long by 2 ft. 9 in. deep, and the glass is ¼ in. plate, backed with pot opal, with a groundwork of dark green enamel with the letters, etc., outlined in gold. The back of the fascia is specially arranged to give adequate reflection.

The large sign is wired in four sections, each section taking 21 100-volt, 30-watt Siemens vacuum lamps, which are spaced 3 in. apart, the small sign over the entrance taking 15 such lamps, all of which can easily be replaced through five doors provided underneath the signs. The lamps in each section are divided into two circuits, and these run back to a 10-way distribution board, and from thence to a Venner time switch and to a main switch and fuse.

The effect at night is very pleasing and cannot fail to attract attention, particularly in main thoroughfares. It is, therefore, an excellent advertising medium, moderate in cost.

The illuminating engineering department of Siemens and English Electric Lamp Co., Ltd., 38/39, Upper Thames Street, E.C.4, will welcome inquiries from the trade for installing these illuminated fascias.

We are indebted to Mr. R. Stephenson, electrical engineer, of 73/81, Goswell Road, E.C., for this photograph.

MINERAL LUBRICATING AND INSULATING OILS.

On Friday, April 4, Mr. A. J. Sear, A.R.C.S., delivered an interesting lecturette on this subject to the members of the Junior Institution of Engineers. After dealing briefly with the mining and treatment of crude oils, Mr. Sear described the physical and chemical properties by which lubricating and insulating oils are usually tested and specified. He said that an investigation of the amount of surface tension of an oil would give much more indication of its lubricating qualities than any viscometer or other test. Emulsification was an important point to consider when water could get to lubricating oil, as in turbines, and vapour tension had to be considered regarding the lubrication of vacuum pumps. Resistance to oxidation and absence of acids were factors which applied to electrical oils more than any others.

Referring to the effect of the presence of water in oil, the lecturer said that this was an important matter when insulation had to be considered, especially if the water contained impurities like hairs and fluff. He showed on a chart the effect of water, varying in proportion from zero to one in a thousand, on the dielectric strength of a particular gap.

The tendency of oil to sludge, he said, occurred when the oil was heated and could oxidise, and although at one time sludging in transformers was thought to be due to electrical action, it was now proved that it arose from purely chemical sources. The question of a proper setting point for transformer oil had to be decided on the merits of each particular case; a high flash point could not be obtained with a low setting point.

The lecturette was illustrated by a number of slides showing oil fields and boring plant, testing apparatus, and also electrical plant which had suffered injury through defects in the oil used in connection with it.

EXTENSIONS AT EPSOM.

We recently had an opportunity of visiting the Central Station at Epsom on the occasion of the official starting up of an additional power unit which, owing to the increasing demand for electrical current, the District Council have been compelled to instal. The station is a comparatively small one, and with a rapidly developing neighbourhood the present available output, even with the recent addition, may soon be fully absorbed. Doubtless for this reason, and with the probability of still further extensions being needed in the near future, the Council decided to adopt the use of engines of the semi-Diesel type, the economy of space required, as well as the transport of fuel question, giving this type of generator features of advantage, especially for an inland town.

The new unit consists of a 4-cylinder engine of the Vickers-Petter semi-Diesel pattern, and of 320 h.p. capacity direct coupled to the 6 pole D.6 dynamo of Holmes manufacture, and of 20 kw. output at a speed of 150 revs. p.m. The starting of the engine at the opening ceremony was effected very simply and easily —one of the ladies present opening a valve on a compressed air container and an assistant turning on the oil supply, the whole operation being carried through and the current available for switching on to main switch-board within three minutes. This is a feature which gives this type of generator great flexibility in the need which sometimes arises to meet sudden demands on emergency in the event of fogs, etc., as well as to carry over peak load requirements occurring irregularly, and should be appreciated by station engineers, more especially perhaps in the case of the smaller provincial towns.

Reviews of Books, &c.

[Books noticed in this column will be sent from ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

THE INSPECTION AND TESTING OF MATERIALS, APPARATUS AND LINES. By F. L. Henley, M.I.E.E. 8vo, 355 pp., 151 diagrams. (Longmans; 21s. net).—This is another one of the series of manuals of telegraph and telephone engineering which are being issued under the editorship of Sir William Slingo and deal directly with the various branches of technical work coming under the control of the engineering staff of the British Post Office. The particular section now dealt with by Mr. Henley is very important and necessitates the employment of a large number of men, many of whom have to be highly skilled electricians, while the ground he covers is wonderfully diverse, ranging as it does from the stress and strain testing of iron and steel in their varied shapes of bar, wire and plate, to the life tests of dry cells and the soldering of wire joints, as well as the testing of telephone sets before they can be approved and passed by the Post Office. The chapter on wood describes briefly but clearly the qualities which are essential in timber for instrument and cabinet work and in the telegraph and telephone poles which are scattered broadcast over the country, thereby adding much to our convenience, although by no means improving the landscape. Copper, indiarubber, earthenware ducts, insulators, valves, galvanometers, telegraph instruments and telephone exchanges all come under the author's comprehensive schedule, and even then he complains that space has not permitted him to cover properly the wide range of items with which the P.O. inspecting staff come in contact, but he has certainly dealt well and thoroughly with all the most important lines of raw and manufactured materials; and he will have the grateful thanks of the large body of readers both at home and in the colonies, to whom the book should prove a most valuable assistant and guide in their endeavours to secure that the goods which they may order or indent for, are actually up to specification. Apart from the personal element, public convenience depends very largely indeed on the quality of the goods used by the Government and other public authorities. The study of this book should be a helpful means to that end.

Various Items.

Finance.—A dividend of 10 per cent, less tax, is being paid to the shareholders of the Brush Electrical Engineering Co., Ltd., for the year 1923.

Blackburn.—The Town Council are proposing to have four electricity sub-stations in Wensley Street, Bold Street, Moorgate Street, and Longshaw Lane.

Easter Holidays.—The works and offices of Messrs. Higgs Bros., Sand Pits, Birmingham, will be closed from April 18 till April 22 inclusive for the Easter holidays.

The Engineers' Club.—During April meetings will be held at this club as follows, namely:—April 11, Inst. of Aeronautic Engineers; 14th, General Electrical Assistants' Assocn.; 16th, Inst. of Production Engineers.

Good Business.—In order to cope with their increasing business in resistance wires, Ella battery chargers, wireless valves and supplies, Messrs. Lionel Robinson and Co., 3, Staple Inn, London, W.C., have extended their telephone facilities by a further line, Holborn 6322, additional to Holborn 6323.

New Order for Vickers.—Messrs. Vickers, Ltd., Barrow-in-Furness, have secured the order for a second unit for the Holborough Cement Works, Halling, Kent, comprising a large rotary kiln and cooler and all subsidiary machinery, including electrical equipment manufactured by Messrs. the Metropolitan Vickers Electrical Co., Ltd.

Blackpool.—At the Town Council, on April 2, Alderman Heap said the Electricity Committee made a profit during last financial year of £21,800, against £12,000 estimated, and the tramways department £20,800, against £20,500 estimated.——The Electricity Committee propose contributing £100 to the electricity display at the Wembley Exhibition.

Meetings.—The Junior Inst. of Engineers will meet on Friday, the 11th inst. Discussion of paper on "Water Tube Boilers," delivered by L. M. Jockel on March 14 (slides). Also on Friday, the 25th inst., lecturette, "Aluminium Electrical Conductors for Overhead Power Transmission," by H. G. Williams (Member) (slides). Both at 39, Victoria St., at 7.30 p.m.

Lytham—St. Annes.—The electrical engineer has reported to his committee that Blackpool Corporation have not yet commenced to extend their main so as to give Lytham—St. Annes a bulk supply. Unless the mains were coupled shortly, he would have to refuse additional consumers from Lytham area, the department having 4,822 consumers—1,000 more than a year ago.

London Electricity District.—The Electricity Commissioners announce that they intend to hold a local inquiry at the offices of the I.E.E., Savoy Place, London, W.C.2, on Monday, May 5, at 10.30 a.m., and following days, if necessary, with reference to the scheme dated March 31, 1924, copies of which may be obtained on application from the Secretary, Electricity Commission, Gwydyr House, Whitehall, London, S.W.1.

Greek Telephones.—We notice in a recent issue of the *Daily Telegraph* that a sixty-six years' concession has been granted by the Greek Government to a British group for an up-to-date telephone installation throughout Greece. The syndicate to whom the concession has been granted comprises the G.E. Co., British Insulated, Western Electric and Lord St. Davids' financial group. The contract will involve several million pounds, and is due to be completed in about three years. This certainly should be of direct advantage to British industry.

The M.-V. "Girl" Calendar.—A charming portrait of Miss Dorothy Hurst adorns the new Metropolitan-Vickers calendar for 1924-5, and is certain to prove an unfailing attraction to the male sex in any and every office which is fortunate enough to be on the mailing list of the Metropolitan-Vickers Co., Ltd., at Trafford Park, Manchester. It is quite possible that many admirers may have already seen her in the "Beauty Prize" at the Winter Garden Theatre and in the "Midnight Follies" at the Metropole, but never looking prettier than in this beautifully reproduced photograph.

Tenders Accepted.—The L.M. and S. Rly. Co. have placed an order with the Siemens and English Electric Lamp Co. for a large quantity of their vacuum train-lighting lamps for immediate delivery.——The Salford Corporation Tramways have accepted the tender of the Siemens and English Electric Lamp Co., Ltd., for a large quantity of their traction type lamps during the twelve months ending March 31, 1925.——The Metropolitan Water Board have accepted the tender of the General Electric Co., Ltd., for a supply of gasfilled lamps for twelve months commencing April 12th, 1924.

Trade Notes.

A new edition of the Megger pamphlet has just recently been issued by **Messrs. Evershed and Vignoles, Ltd.**, of Acton Lane Works, London, W.4. It is an excellently printed book of 40 pp. and is certain to prove of direct interest to all electrical engineers, as the company have gone more fully into the development and working of the well-known Megger testing sets than has been previously possible. In fact, the whole pamphlet has been entirely re-written, and the illustrations and diagrams are so wonderfully clear and explanatory that it should prove of real practical value as a text book to every person who has to undertake testing work for which the Megger, Bridge-Megger and Meg are suitable.

Messrs. Bennett and Jennison, Ltd., of Ladysmith Road, Grimsby, have in stock a quantity of dry redwood casing which they are offering at remarkably low prices. For particulars see prepaid advt. page.

Parts 1 and 2 of catalogue W.M. 124 have been issued by the **Westinghouse-Morse Chain Co., Ltd.** These catalogues illlustrate and describe the Westinghouse-Morse Rocker-Joint Chain Drives, as manufactured by the company at their works at Letchworth, for all kinds of high speed, high efficiency, power transmission, and as such should prove of direct interest to all readers who are in any way connected with the mechanical transmission of power, to whom the lists will be sent free on application mentioning this notice.

A most interesting pamphlet entitled "The Evolution of the Electricity Meter" has been issued by **Messrs. Robt. Hornby and Co., Ltd.**, of 7, Carlisle Street, London, W.1. It gives a condensed but at the same time a most comprehensive survey of the development of the electricity meter from that invented by Edison in 1881 onwards, with illustrations showing the types introduced by Bastian, Wright, Aron, Siemens, Schuckert, Peloux, Hummel, etc., right away to the very latest of the Siemens-Schuckert meters now on the market, and should prove of direct educational value to all who have anything to do with electricity meters. Messrs. Hornby will be very pleased indeed to send a copy to any interested reader on application.

A pamphlet describing and illustrating the new showrooms of the **Corporation of Halifax Electric Supply Department** has just been issued by the Corporation under the advice of its electrical engineer, Mr. W. M. Rogerson. It gives good illustrations of the advantages of electricity for the home, and should most certainly help to increase the demand for current in this go-ahead town.

The monthly price list for April has been issued by the **Siemens and English Electric Lamp Co., Ltd.**, of 38/9, Upper Thames Street, London, E.C.4, and will, as usual, prove of direct value to all electrical contractors and retail dealers in electrical supplies, to whom it will be sent on application.

A booklet entitled "Surface Tension" has been published by the **Henry Wells Oil Co.**, of 11, Haymarket, London, S.W.1. It contains much hitherto unpublished information on lubrication, and should therefore be of direct interest to all in charge of motive-power machinery, to whom it will be willingly sent on application mentioning this notice.

Quotations Wanted.—The lighting department of the Copenhagen Municipality invite tenders for the supply and delivery of one electrically driven gas pump which must be able to pump, in daily use, at least 4,000 cubic metres of gas per hour against a pressure of 5 metres column of water.——The Department of Sanitary Works of the Nation at Buenos Aires invite tenders for the supply, delivery and erection of the machinery and materials required for an electric power station and pumping stations to be installed in the town of Pergamino (Province of Buenos Aires).——The Signalling Department of the Chilean State Railways at Santiago is inviting tenders for the supply of the following requirements:—Group B: Table and wall telephones, switchboards, fuses, etc. Group C: Copper and galvanised-iron wire and cables. Group D: Galvanised-iron anchors for posts; stays, insulator pins, etc. Group E: Cast-iron covers for cable boxes, padlocks, galvanised-iron piping, lead tubes, etc. Group F: Dry cells and material pertaining thereto. Group G: Tar, timber for posts, etc. Group H: Welding apparatus, hand-saws, trucks, etc. Group I: Insulators (bell-shaped). Group J: Concrete conduits. Specifications, etc., at the D.O.T. (Room 52), 35, Old Queen Street, S.W.1.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

APRIL 18, 1924.

CONTENTS. PAGE

Electric Driving of a Modern Factory 197
Air-Break Control Gear for Small A.C. Motors 198
Development of the Bellini-Tosi System of Direction Finding in the British Mercantile Marine 199
Current Topics 203
Westinghouse Dual Frequency Super-Calender Drive .. 205
Scientific Illumination at Whiteley's 206
Telephony (Solutions) 207
Questions and Answers by Practical Men 207
Various Items 208
Trade Notes 208

ELECTRIC DRIVING OF A MODERN FACTORY.*

By F. W. Smith, N.A.S.E.

The meeting was presided over by the President, Mr. W. E. Highfield, M.I.E.E., and the attendance was a tribute to Mr. Smith and the Association. A number of lantern slides were shown to illustrate the lecture, and the audience followed the proceedings closely. Mr. Smith opening his lecture said :—

Mr. President and Gentlemen,

I am very conscious of the fact that I stand before you as a substitute for one of the greatest authorities we have on modern electric driving, and it was with a feeling of deep regret I heard that Mr. Frank Broadbent, M.I.E.E., would be unable to take this subject to-night. However, I trust that at some future date we shall have a paper from him, which I know will be both interesting and instructive.

You have asked me to give you a paper on electric driving of a modern factory, the class of factory you have kindly left to me. If I may say so, it would have been much easier for me had you stated the factory you wished me to illustrate, for, as you know, most modern factories are driven by electricity—it would be hardly modern, at least in our view, if it were not electrically driven, perhaps some of our oil-engine friends would not allow that.

Perhaps one of the most important factories we as electricians have to electrify is that of the printer, and it is for that reason I have selected this for my paper to-night.

We need not concern ourselves with the supply or the wiring, as no doubt this will form a subject for a paper at some future date; it may, however, be advisable to touch later on upon the distribution and lay-out if we have time to-night.

I believe I am right in saying there is no industry which lends itself so admirably to electric driving as that of printing machinery. Electricity reduces the cost of production, increases the output, is more flexible and accurate than any other form of driving. The reduction of costs is largely due to the fact that individual driving can be adopted, resulting in a great saving over that in which one large engine is used for driving the whole works, while 60-70 per cent. of the power developed by an engine is wasted in line shafting, counter-shafts, pulleys and belts. Maintenance also is another big item to contend with, such as the "always running belt," the never ending oil-can, repairs to engine, loss of time in starting up, and danger to work-people. All these things are entirely eliminated where individual driving by electric motor is adopted.

With electric driving properly applied one is able to run just the printing machine one wishes, without driving unnecessary shafting and without having to run an engine large enough to drive the whole works. Then again, should a breakdown occur on a machine, only that machine is thrown out of commission, the rest of the factory is left running as though nothing had happened—this fact alone accounts to a large extent for the rapid way in which electric driving has superseded steam, gas and oil engines in large and small printing works.

In a printing office we have to deal with a large number of different drives and h.p.s ranging from ¼ h.p. up to 80 and even 180 h.p. (The last figure refers to recent rotary presses, while the former denotes the power required for stitchers and other small machines.)

At one large printing office in which I had the privilege of working under a great printing-machine driving authority, individual driving was adopted throughout, each machine had its own motor properly rated and applied, even down to ¼ h.p. size motors, and it has been proved that even on these small machines a considerable saving in running costs has been effected over that of the group drive by which they were originally driven.

Cutting, embossing and stamping machines are straightforward drives and will need no explanation from me, beyond reminding you that these work very intermittently, and should be driven by separate motors.

The flat-bed wharfedale machine is perhaps the most familiar to you, and is the one which you are most often called upon to electrify. These machines are required to work very intermittently and must be capable of speed variation through a very wide range, from a few impressions when making ready, to in some cases 2,000 or more impressions per hour when running at full speed, the speed from minimum, say, 800 impressions, to top speed must be smooth and gradual and arranged to run continuously at any speeds between the minimum and maximum; this is very necessary if we are to get the most out of the machine. It is estimated that with the modern drive as much work can be turned out in nine hours as would be done with the old method in 10½ hours, an advantage which must be apparent at all. Mr. Frank Broadbent, M.I.E.E., puts this increased output due to electric driving at 20 to 30 per cent., which has actually been attained in several works designed by him.

It is impossible to lay down any hard-and-fast rules in regard to driving of printing machines, each machine must be treated on its merits, and to that best suited to its requirements. There are four methods of driving, each has its own particular advantages: belt, spur, chain and direct-coupled, the latter is not used in this country, and is, I understand, falling into disuse on the Continent, where it originated.

---

* Lecture delivered before the N.A.S.E.

There is no difficulty in driving a printing machine by electric motor, but there is a right way and a wrong way, and it is only by studying the individual requirements of each machine that the best results can be obtained. No doubt belt driving by means of a jockey-pulley is by far the simplest method, and is one which is being used more and more in printing works. Economy of space is an important consideration, and this drive makes it possible to place the motor at the back of the machine, and in some cases it can be tucked away inside the press frame. Two-revolution presses are particularly adaptable to this method of driving. The jockey-pulley is divided into two parts and is fixed to the nose of the pulley end bearing, one part carrying the jockey-pulley, which is held in tension by a spring attached to an adjustable arm, and is capable of adjustment in any position round the motor pulley. It, as you will see, forms part of the motor, and makes a neat, compact and highly-efficient drive.

It has been said that the jockey-pulley drive is wasteful in power and destructive to the belt. This argument is quite good only when the jockey-pulley is operating on the pulling side of the belt, which, of course, should never be done, as the object for which the jockey was designed is destroyed.

I have seen scores of these drives, and some I know have been in constant use for eight years without giving the slightest trouble.

(*To be continued.*)

AIR-BREAK CONTROL GEAR FOR SMALL A.C. MOTORS.

(*Continued from page* 186.)

TYPICAL AIR-BREAK CIRCUIT BREAKER.

Fig. 1 illustrates a typical totally enclosed air-break "Mill" circuit breaker for use on supply authorities' mains instead of home service switch fuses, and in mills, factories, workshops and non-gaseous mines to control and protect distribution circuits, motors and kindred apparatus. Such a breaker meets completely the requirements of the Factory and Mining Acts.

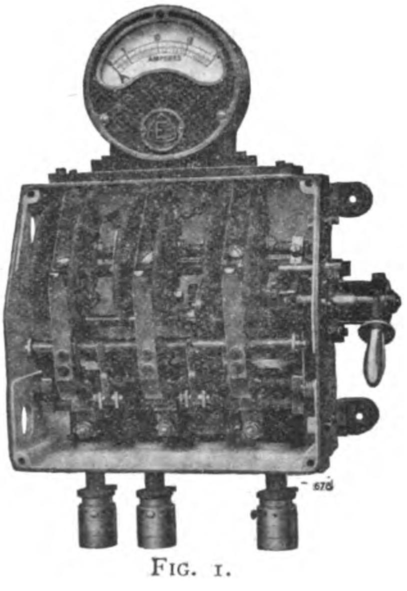


FIG. 1.

The breakers are contained in substantial cast-iron cases, the covers being secured by four steel set screws, one of which may be countersunk and sealed if required. The boxes are made dust and weatherproof by means of a gasket between the cover and the case, so that a stream of water from a hose can be directed upon it without risk of injury if the cable entrances are properly closed. No breakable materials, such as marble, slate or porcelain are used in the construction. The current-carrying parts, which are of ample section, being mounted on steel rods covered with "Bakelite" paper tubes. The final interruption of the current occurs at substantial sparking tips, so disposed that they maintain good contact even when worn, and are easily and cheaply renewed. The speed of the break is very quick, being approximately 8 ft. per second at the end of the travel, and the break itself is long. Each breaker is fitted with one "free handle" only, which suffices for closing and for quick break hand-release. This handle, which is a massive brass casting, has its movement in either direction restricted by solid cast-iron stops, plainly marked to show the "off" and "on" positions, and no undue stresses can be thrown on the internal moving parts.

A series-connected magnetic blow-out coil is fitted and so arranged that it is normally short-circuited when the breaker is closed, the magnetic field being established when the main brush leaves its contact. This magnetic field is set up between heavy cast-iron cheeks which are vitreous enamelled and serve as fire-proof barriers between the poles. The reactance of the blow-out coil is kept as low as possible to prevent pitting of the main contacts while providing sufficient blow-out effect on the whole length of the arc which forms between the sparking contacts placed in the enclosure between the magnetic cheeks. This ensures the maximum breaking capacity being obtained.

The non-automatic type, which are constructed for opening and closing by hand only, should be used on all important circuits instead of knife switches. The magnetic blow-out feature is retained because the breaker, although never required to deal with short-circuit conditions, may be required to break any current up to the overload setting of the breaker or the fusing current of the fuses protecting the circuit. This, in some instances, may be as much as two or three times the normal full load current.

The automatic type are similar to the non-automatic, except that they are fitted with various trips and releases. No-volt, overload, shunt, leakage, and remote trip can be fitted either separately or in various combinations. The settings of the overload coils may be adjusted between normal full load and 100 per cent. overload, the standard calibrations being 25, 50, 75 and 100 per cent. overload. These overload trips should not be set for a greater load than the motor or circuit can safely carry. For this reason time-lags should be fitted to prevent momentary overloads tripping the breakers unnecessarily, and such time-lags should be adjustable in order to obtain any desired retardation to meet the actual conditions of service. The device should have a true inverse time element, so that the time the tripping mechanism is delayed diminishes as the overload increases, and on very heavy overloads or short circuit conditions the breaker should open instantaneously. The mechanism should be simple and its principle of operation such that under no conceivable conditions could the device prevent the breaker opening if an overload has been on long enough to be dangerous. Such a time-lag, consisting of a dash-pot containing a certain quantity of oil or other suitable fluid, is shown fitted to the above gear. The principle feature of its design is the tapered piston and correspondingly bored cylinder. The object of this tapered form is to permit adjustment of the retardation, for as the time occupied in raising the piston is determined by the rate of flow of the oil, it is evident that if the aperture round the piston is increased by lowering the cylinder the rate of flow will be increased and the time required to pull up the piston reduced. The trips and time-lags can be totally enclosed and locked, so that interference by unauthorised persons is prevented.

Limiting Starting Current.

We have already seen that when a S.C. motor is thrown direct on to the line there is a rush of current at start, and on large machines it is necessary to devise some means of keeping this current rush within reasonable limits. This can be done by connecting a variable choke coil in each phase of the stator or inserting a variable resistance, but the most usual methods of starting are either by means of star-delta connections of the stator or by an auto-transformer starter.

The former is by far the simpler method, and in general is used for motors up to approximately 20 h.p. Now the starting torque of an induction motor varies as the square of the voltage per phase. Further, the torque is proportional to the product of the flux and the rotor current. Hence, if the normal applied voltage is, say, halved, then the flux (neglecting saturation), the e.m.f. and the current induced in the rotor will also be halved, so that the torque will only be one-quarter of its original value. With star-delta method of starting the voltage per phase at the starting is $\frac{1}{\sqrt{3}}$ of the line voltage, and consequently the starting torque will only be one-third of that obtained by throwing the motor direct on to the line. It follows, therefore, that star-delta starting is not suitable where the motor is required to develop heavy torque at start.

In the auto-transformer starter a series of tappings are taken from the transformer giving usually .5, .6, and .75 of the line pressure. By this means the rush of current can be adjusted as required, but the starting torque will, of course, still remain below that obtained by switching the motor direct on to the mains. Further, it is obvious that, as far as the effect on the line and on the motor is concerned, there is no difference between an auto-transformer using the .6 tapping and a star-delta starter. The current rush and the starting torque remain the same in both cases.

The auto-transformer starter can be used with two- or three-phase motors, but the star-delta starter is obviously only suitable for three-phase work. It is possible, however, to arrange the windings of a two-phase machine for series-parallel starting. In this case each of the two-phase windings are divided into two parts, so that at start the two parts are in series, and when the motor is up to speed the connections are changed, putting the two parts in parallel. When in parallel they are suitable for full voltage, and consequently when arranged in series the starting current cannot be very large.

(To be continued.)

DEVELOPMENT OF THE BELLINI-TOSI SYSTEM OF DIRECTION FINDING IN THE BRITISH MERCANTILE MARINE.*

By Com. J. A. Slee, C.B.E., R.N. (Ret.), Member.

Summary.

The paper gives an account of the various sources of error which have been encountered during the development of the Bellini-Tosi system of wireless direction finding as an aid to navigation in the British mercantile marine. These errors can be isolated and their causes removed one by one.

The application of the instrument to the purposes of navigation is also dealt with, and the possible errors, external to the ship, which may be encountered are considered.

(1) Retrospect.

The following notes concern the development of direction finding on the Bellini-Tosi system, in which two fixed loop aerials, at right angles to one another, are used in conjunction with a rotatable search coil. The results mentioned have been obtained with spark (as opposed to continuous-wave or interrupted continuous-wave) telegraphy.

The first attempts were made with loop aerials, each tuned independently to the frequency of the signal the direction of which it was desired to obtain, the loop aerials being very loosely coupled to the search coil and its circuits. This system, which had given admirable results on land, was found when fitted in an iron ship to be too difficult to work, and to possess too grave errors of a quadrantal nature to be of practical value for navigational purposes, the only justification for its existence in the mercantile marine.

The method of using untuned loops, usually, though incorrectly, called aperiodic loops, was then resorted to, and promising results were at once obtained.

(2) Errors Encountered.

(*a*) *Calibration error.*—In all that follows, the word "loop" is used to convey the idea of the whole arrangement used to absorb energy from the ether, including the field coil, lead-covered cable and junction boxes, as well as the simple loop itself. The capacity present in this circuit is a complex quantity, of which the greater part is the capacity between core and core of the lead-covered cable. Such a circuit has a well-marked natural frequency. The expression "simple loop" is used to denote that portion of the whole which is purposely opened out so as to enclose a considerable area.

An analysis of the nature of the errors obtained when identical loops were used brought forward the fundamental conception on which all subsequent work has been based; that is to say, the idea that the ship herself, with all her rigging, might be imagined to be replaced by a fictitious simple loop lying in the vertical plane and parallel to the keel-line of the vessel. The action of this fictitious simple loop is taken into consideration when determining the area of the fore-and-aft loop of the complete direction-finder system.

Since this fictitious simple loop is fore and aft, and since its effects cannot be ignored or eliminated, and must not be allowed to produce an effect equivalent to mutual induction between the two tangible simple loops of the aerial system, it is clear that one of the two tangible simple loops must be parallel to the fictitious simple loop, that is to say, fore and aft. Therefore the other tangible simple loop must be athwartships.

---

* Paper read before the I.E.E.

Since the tangible fore-and-aft simple loop is coplanar with the fictitious ship simple loop, there will be considerable coupling between these two, and therefore the current circulating round the tangible fore-and-aft loop will, under any given conditions, be greater in some geometrical proportion than would be expected from a consideration of the dimensions of the fore-and-aft loop alone.

If identical loops were used, the result of the above would be that the directions as observed would tend to be crowded towards the fore-and-aft line, the error being a maximum when the correct relative bearing is on the bow or quarter, and vanishing when the correct relative bearing is abeam, or ahead, or astern.

This error, which is now in practice usually given the name of "calibration error," can be completely removed by reducing the area of the tangible fore-and-aft loop, or by adding to its impedance, or by a combination of these two methods. It is usual in practice to employ the largest convenient thwartship loop (up to an area of about 400 sq. ft.), and to adjust the size of the fore-and-aft loop until a slight calibration error remains, finally removing it by adding impedance equally to the two limbs of the fore-and-aft loop.

(*b*) *Loop-tuning error.*—The last paragraph shows that the two loops are essentially of different dimensions, and, therefore, in all probability, of different natural frequencies. If both the loops are very considerably different in frequency from that of the signal to be received, the current circulating in each will be almost in quadrature with the voltage applied by the incoming wave, and therefore the currents flowing round the two loops will be almost exactly in phase with one another. Further, the value of the current reached in each loop will be almost exactly proportional to the voltage applied to that loop by the incoming wave.

If the first of these two conditions (similarity of phase of circulating currents) is not made good, the familiar rotating-field effect will be produced on the search coil. Since the position of zero coupling between the search coil and the field coils which are connected to the loops is the index by which directions are measured, the effect of such a rotating field is to fog the observation by obscuring the position of zero signals.

Also, if one loop happened to be of the same, or very nearly the same, frequency as the incoming wave, the circulating current round it would be greater, in proportion to the voltage applied, than the current in the other loop (by hypothesis of different frequency) and, therefore, less nearly in resonance with the incoming wave. Therefore, the proportionality between impressed voltage and circulating current will be different in the two loops, and a quadrantal error similar in effect to calibration error will result. Its extent will vary with alteration of wave-length of the received signal, and will vanish if the frequency of the incoming wave is midway between the frequencies of the two loops. As such an error varies with wave-length, it is quite inadmissible. These two effects of one cause are in practice lumped together under the name of "loop-tuning error." They can be completely avoided by fitting loops of suitable dimensions in the first place, and are almost unheard of in practice.

(*c*) *Lack-of-symmetry error.*—If we consider the current flowing in any part of a vertical loop under the influence of an incoming ether wave, it is clear that there are two distinct components. One is a circulating current round the loop. The cause of this current is as follows:—

If we imagine each half of the simple loop from apex to junction box to be replaced by its phantom vertical projection, the incoming wave will induce a voltage between the two ends of each phantom projection, the potential to which each of these four ends is raised at any instant, by effects of the incoming wave, being different. If the plane of the simple loop is not parallel to the wave-front, the voltages induced in the two phantom vertical projections will be unequal, and the difference between them is the useful voltage available for the production of a circulating current. For brevity, this current is in practice called the "loop current," and clearly the instantaneous value of the voltage causing it depends upon the height and distance apart of the phantom projections (in practice, the area of the loop) and the rate of change of intensity of electric and magnetic stresses caused by the incoming wave at the instant under consideration.

The other component is a simple alternating current flowing in both sides of the complete loop from the apex to the mid-point of the field coils, the actual current distribution being to a great extent governed by the capacity to earth of the various parts of the loop. For the sake of brevity this current is in practice called the "plain current," and the instantaneous voltage to which it is due is caused by the instantaneous value of the electric and magnetic stresses set up by the incoming wave.

Hence we see that the "loop" voltage and the "plain" voltage are in quadrature, the loop current leading or lagging relatively to the loop voltage in accordance with the electrical constants of the loop circuit, while the plain current will lead or lag relatively to the plain voltage in accordance with the electrical constants of the plain circuit.

If the construction of the loop and its attendant field coil is perfectly symmetrical electrically, the plain current will be equally divided between the two halves of the loop, and the effects of each half of the field coil on the search coil will neutralise one another.

Absence of this condition of symmetry is the most troublesome, the most common, and the most dangerous source of error. It is generally called in practice "lack-of-symmetry" error, and the satisfactory operation of direction-finders on board ship is almost entirely a question of the success with which causes tending to produce or accentuate this error can be counteracted.

In order to protect the insulation of the connections between the loops and the direction-finder instrument, and also the windings of the field coils themselves, from the effects of accumulated static charges or the induction due to transmission, the centre of each field winding was at first connected direct to earth. This direct connection accentuated the effects of lack of symmetry, and has since been replaced by a suitable inductive choke.

(*To be continued.*)

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of
CORRECT ARTIFICIAL LIGHTING

Advert of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

Those Breakdowns.

An interesting report which reaches me from Nelson, Lancashire, regarding a recent electricity supply breakdown which plunged the town into darkness, points a moral which should be acted upon by mains superintendents and others responsible for the distributing networks of our cities and towns. In the Nelson case, the failure was due to the act of certain workmen of the General Post Office, employed in laying cables for the department, and who damaged the electricity supply cables with a pick. It was reported that this was the fourth occasion upon which damage had been done to the electricity supply cables by other authorities without the electricity department being informed of the fact. Had the damage been reported at once, it could have been repaired and the breakdown averted without inconvenience to the public.

The moral in this case would appear to be that in the case of Nelson, at all events, no proper plan of the existing mains exists, or, if such a plan does exist, there is insufficient co-ordination between the various authorities empowered to break up the roadway to ensure that before doing so precautions are taken to ensure due clearance and safety for existing buried mains of all kinds. The case of Nelson is by no means an isolated one, and there are doubtless innumerable networks of which the past and existing records are meagre and inexact, with the result that any workmen penetrating the surface may readily and quite involuntarily do considerable damage within a few minutes of commencing operations. It is the old story of lack of co-ordination between responsible authorities. In these days of numerous buried mains of all kinds in every busy street, the accuracy of the municipal plans showing their disposition should be unquestionable. Furthermore, no authority, whether Government or municipal, company or private, should be permitted to break up a single square inch of the ground thus occupied without first applying to the keeper of such plans for the necessary authority and information regarding the mains in the district.

In connection with electricity failures, the inevitable has happened, and life has been lost as a direct result. Only a few weeks ago I commented on the urgent necessity for providing alternative emergency lighting equipment in hospital operating theatres, so that possible electric light failure at a critical stage during operations might not seriously endanger the patient. Now such a casualty has actually been reported from the West Middlesex Hospital, where the electric light failed during the progress of a critical operation on an elderly woman, with the resultant delay which culminated in her collapse and death. The operating surgeon stated at the inquest that the operation would otherwise have been successful. If it is ever my misfortune to have to undergo an operation of a serious nature I shall endeavour to persuade the hospital staff to guard against this contingency before putting me through it. For a similar reason I instinctively seek an electrically-lighted railway carriage in preference to one still illuminated by gas when travelling by train.

"Chartered."

The prestige attaching to Membership of the Institution of Electrical Engineers is now enhanced by a new by-law recently adopted at a special general meeting, and allowed by the Lords of His Majesty's Most Honourable Privy Council. The by-law runs as follows:—"Every Member and Associate Member is, and is entitled to describe himself as, a Chartered Electrical Engineer, and in using that description after his name shall place it after the designation of the class in the institution to which he belongs, stated in accordance with the following abbreviated forms, viz., M.I.E.E. or A.M.I.E.E. as the case may be." This new mark of status will serve still further to distinguish the true professional electrical engineer possessing the necessary qualifications from the so-called electrical engineer of the pliers and bull-dog tape order, whose knowledge of essential principles of electrical engineering is strictly limited but whose loose denomination has hitherto misled the general public.

A Novel Case.

A case of considerable interest to wiring contractors was recently decided at the Shoreditch County Court. It arose out of a claim by an electrician against a shopkeeper for £11 for electrical installation work carried out on the trader's premises. The execution of the wiring and fitting was not denied, but it traspired in the course of the evidence that the completed installation could not be connected up to the public supply mains on account of the distance separating the shopkeeper's premises from the nearest main, which precluded the connection on the score of cost of running an individual service. The plaintiff's case was weakened by the fact that a letter was written by the borough council pointing out the impossibility of connecting the premises and was duly received by him before he had completed his installation work.

In spite of this plain warning of what the outcome was likely to be, he reassured the client and continued with the work, well knowing that it would serve no useful purpose even when ready for connection. Very justly the Court non-suited the plaintiff, holding that he was entitled to payment for work done only when the defendant was successful in securing the desired connection with the supply mains at some future date. The principle of thus misleading a client for the purpose of securing a contract, which it is self-evident will lead to disappointment when completed, is to be deprecated. It does harm to the industry as a whole, and brings the wiring and contracting branch of the business into disrepute. The straightforward policy in such a case would have been to explain the position clearly to the client at the outset, and then endeavour by canvassing or otherwise to secure the necessary local support for a mains extension on reasonable terms. When a would-be consumer places himself or herself in the hands of a wiring contractor a fair deal is implied, and the case above cited could under no circumstances be classed as such.

Emigration.

Lord Leverhulme, who has just returned from a tour of the world, strongly advocates emigration as a partial cure at all events for the overcrowded labour market and consequent unemployment in this country. Referring to opportunities which await the enterprising and willing worker in overseas Dominions, he states in a recent article:—"I consider that the most dangerous operation of what we call the 'dole' is that it starves the hardy spirit of adventure, and causes the unemployed to stand shivering on the brink rather than to make a bold plunge to success and fortune overseas." In a further announcement made at Swinton, Lord Leverhulme unconsciously revealed the fact that he had been spending recent months out of England, for he claimed that "If anyone wants to live comfortably and work reasonably there is no climate that will help them better than that in England, and there is no part of England where the climate is better than in Lancashire." Considering that Lancashire is at present experiencing what amounts to its seventh month of almost continuous wintry conditions, Lord Leverhulme's commendation of the county is open to criticism.

Wembley and "a-Wembling."

I'm afraid that, in spite of my Irish temperament, I'm just as bad as the average fellow in taking my time to get enthusiastic. About Wembley, for instance. Wembley is really only just beginning to be known as the site, or, rather, as the affair itself, of the British Empire Exhibition. Of course, I am speaking in a general and not merely local (*i.e.*, London) sense. It is admitted everywhere (almost with an air of pride) that we don't want to "blow our own trumpet"—we don't want our self-conscious selves to be exerted in that way at all, let alone show any particular interest. And so here a great Exhibition comes into being, and we are just awakening to the fact and to all that it portends.

An Empire Exhibition!

Yes, I confess that I've been as lax and uninterested as most of us over the matter. Just a short while ago the mere idea of travelling down to London and even *incidentally* visiting Wembley never entered my head. But some subtle sort of change has been taking place. I've begun to feel curious—always a suspicious sign! And here before me is one of the causes. It is an imposing leaflet descriptive of the Exhibition, and specially produced for the edification of the American editors. (How I admire the courage of the authorities!) And say, Bo', it sure is some stunt. "London's Fifty Million Dollar Exposition"! And fifty million visitors expected!

Gee! What's this? "*More than 3,000,000 electric lamps, great and small, will illuminate the grounds and palaces at night.*" And, darn my optics, here's "*a tropical fish, 16 ft. long, 14 ft. broad, which has a mouth 3 ft. wide and eats its own parents.*" Holy smoke! These guys must have a darn big stock of fish-parents waiting to be chawed up by said hungry and thankless offspring, eh? Guess I'll have to hike to Wembley after all. In the words of the poets:—

"*The world's all a-Wembling,*
And we must Wemble too!"

So will somebody tell the Exhibition authorities to revise their figures, please? There will be fifty million *and one* visitors.

The Stand at Wembley.

There's one stand you must not pass by, however bored you are, and that stand is this paper's. You will see a veritable library of books displayed, and you will be at perfect liberty to linger as long as you like among them. Many a time you will have vaguely wished for a certain book, but never had the chance to have a look through it, let alone buy it. That book will be there. Or there may be some specialised knowledge for which you have long been searching. Just see if it isn't waiting for you on ELECTRICITY's stand. It isn't every day you have the chance of browsing among a variety of useful and fascinating books. The average bookstall is by no means the helpful and hospitable place it should be. *Our* stand will be "open house." So do look in, even if only for a talk or information. And an ELECTRICITY reader will be doubly welcome.

ELEKTRON.

B.E.X.—"Women and Wembley" is the title of a very neat little brochure which has been issued by the authorities of the British Empire Exhibition. It deals with the Women's Section, of which Mrs. C. C. Grove is the secretary, and contains much matter which will appeal to the ordinary housewife who may be visiting the Exhibition. In it special reference is made to the host of electrical appliances for labour saving in the home, which will provide her with ideas to put into operation as and when occasion requires. For this reason alone the pamphlet should be read by all electrical men and passed on to those to whom it will be of more direct interest.

An International Radio Exposition.—Final arrangements have just been made for the world's first annual international radio show, which is to open at Madison Square Garden, New York, on Monday September 22, and continue until Sunday night, September 28. It is claimed that it will be the largest and most complete show of its kind ever staged anywhere, and will be held under the auspices of the newly organised Radio Manufacturers' Show Association, composed of sixty of the most prominent American radio manufacturers. It is to be held every autumn until 1934 The Association has also taken over the Chicago Coliseum for a like period, and another ten year's lease is being negotiated on a new Western exposition building. An outstanding feature will be the introduction of foreign exhibits. Several of the leading European manufacturers have applied to Manager Kerr for space, and he is now trying to re-arrange his plans so as to enable them to have a section of their own. Over seventy per cent. of the available space has already been taken, and important foreign and domestic applications are coming in by every mail.

WESTINGHOUSE DUAL FREQUENCY SUPER-CALENDER DRIVE.

By O. C. Cordes
(Paper Mill Section, General Engineering Dept., Westinghouse Electric and Manufacturing Co.)

The super-calendering of paper is one of the important operations in the finishing of many kinds of paper. It is here that the paper is given the finish peculiar to the needs of the various users, such as printers, lithographers and stationers. This operation is an art rather than a science, and much depends upon the calender operator to produce the particular finish required.

The raw paper as received from the paper or coating machine is passed through the super-calender, where, according to the kind of calender rolls and the weight applied, the required finish is given to the surface of the paper. The operator of the calender is entirely responsible for the finish. The amount of weighting and the speed of calendering is all determined by rule of thumb and experience.

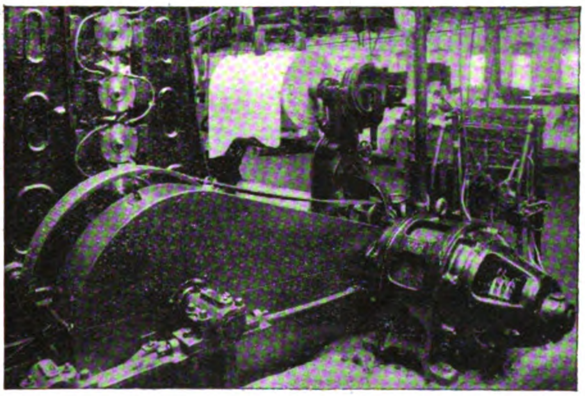


Fig. 1.—Typical View of Motor and Enclosed Chain Drive to Calender Stack.
Also showing rear of control panel. The small space requirements are evident.

There are usually but two speeds required in connection with the calendering of paper; these are known as "Threading-in" and "Running." However, at times it is quite desirable to have intermediate speeds, so that the calender can be slowed down for bad or weak spots in the sheet. The "threading-in" speed is normally about one-tenth the full running speed. The method of super-calender motor drive most prevalent at the present time, and up to the time of the conception of the Westinghouse Dual Frequency Drive, involve either a single or two-motor equipment. The single-motor drive obtains its "threading-in" and "running" speeds by means of suitable gear reductions and clutches. The two-motor drive utilises two motors, the larger of which drives the calender at "running" speeds through a spur gear reduction. The small motor drives the calender at "threading-in" speeds, through the larger motor by means of an additional gear reduction and an over-running clutch.

The Westinghouse Dual Frequency Drive was designed primarily to eliminate the necessity of a large gear reduction, or a separate motor with its gear reduction and over-running clutch for obtaining the "threading-in" speed. For this drive both the "threading-in" and "running" speeds are obtained from one motor through a single gear or chain reduction to the lower calender roll. It is self-evident that from a mechanical standpoint this is a less complicated drive and requires less space than either of the other two principle systems of drive.

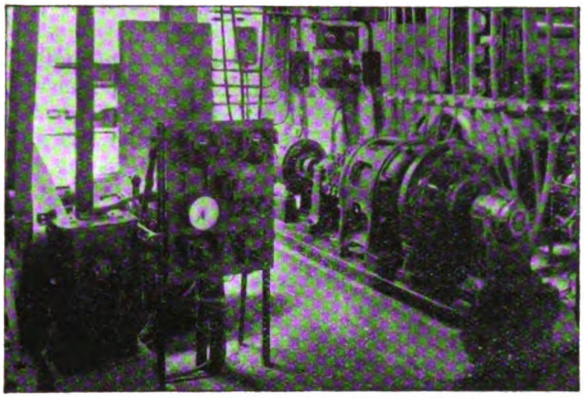


Fig. 2.—Frequency Changer Set, of Sufficient Capacity for Nine Calender Stacks, Together with its Transformers.
Also drum controller, with contactor panel for one calender. Six-cycle and sixty-cycle cables are shown back of frequency changer.

The Westinghouse Dual Frequency Drive consists of a single motor which drives the lower calender roll through one chain or gear reduction, a control panel, a controller, stop push-button stations, necessary safety switches and a frequency changer set together with the required transformers. The frequency changer set reduces the primary voltage and frequency to approximately 10 per cent. of its normal value. This reduced frequency and voltage, when impressed upon the motor, causes it to rotate at approximately 10 per cent. normal speed, which in turn produces the desired "threading in" speed on the calender. From the

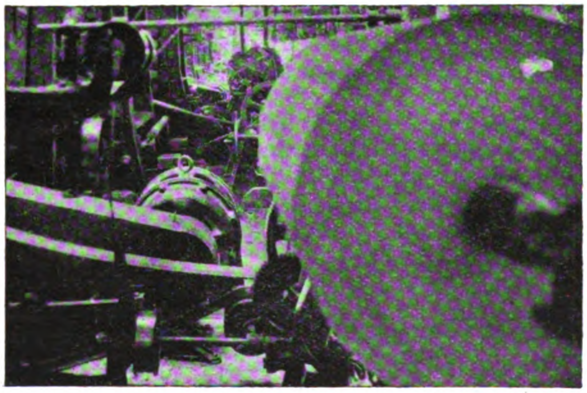


Fig. 3.—View in Calender Room Showing Seven or Nine Calender Stacks, Together with Motor and Chain Drives.
Observe small amount of space taken by the driving equipment. The leather link belt which drives the calender reel is also shown.

standpoint of first cost, a type of drive such as this is, of course, most economical where two or more calenders are installed.

The motor is of the wound rotor type, and is designed to have a high starting torque at the low frequency, so that it will be able to start the super-calender stack under the most extreme load conditions. The controller operates in conjunction with the control panel as follows.

The first step of the controller connects the motor to the low-frequency source with all secondary resistance cut out. The second step disconnects the motor from the low-frequency source and connects it to the high-frequency source, and inserts resistance into the rotor circuit. The subsequent steps serve to cut out the secondary resistance in the rotor circuit until full speed on the motor has been obtained. The secondary resistance is so designed and adjusted as to give smooth acceleration from "threading-in" to production speeds, thus avoiding paper breakage. "Stop" push-buttons are provided for mounting in desirable places, so that the calender can be stopped without having to touch the controller. However, in order to again start it is necessary to return the controller handle to the "Off" position and come up through the low-frequency point to the running speed.

The frequency changer is of the commutator type, and is a specially designed machine for frequency conversion. The armature of this machine is similar to that used in rotary converters. The commutator brush gear, however, is arranged for three-phase current, and requires three equally spaced brush arms per pair of poles. The stationary part consists of a laminated core built up in a cast-iron frame similar to that of an induction motor. Excellent commutating conditions are obtained over its entire load range due to its rotary converter action and special design features.

The action of the machine in changing the frequency is somewhat similar to a rotary converter, but, instead of operating at synchronous speed and producing direct current, it is operated at a speed a few per cent. below or above synchronous speed, and therefore delivers a current having a frequency proportional to the percentage which the armature speed is above or below synchronous speed. The machine is usually designed to operate at such a percentage below synchronous speed as to give the desired "threading-in" speed on the calenders.

The frequency changer itself may be driven by a small direct-current motor of sufficient size to overcome the mechanical friction of the set, or by an induction motor of a similar size and suitable speed characteristics, and in some cases may be designed to operate at the required speed without the use of a driving motor at all. The load on the small driving motor is not affected by the load on the frequency changer.

(To be continued.)

"Heat Treatment Bulletin No. 32," which has been issued by the **Automatic and Electric Furnaces, Ltd.**, of 175, Farringdon Road, London, E.C.1, deals with the subject of "Carburisation," and has been written by Mr. J. W. Urquhart, the well-known electrical engineer. It gives a carefully worded description of the author's inspection of the self-controlled furnace as manufactured by the company, and the results obtained from the tests made, and should therefore be of direct value to all steel users.

SCIENTIFIC ILLUMINATION AT WHITELEY'S.

We are able to reproduce, by the courtesy of Messrs. William Whiteley, Ltd., photographs of two departments in their premises in Queen's Road, showing the reorganisation of the lighting arrangements which is now being carried out. The general scheme is a row of sphere pendants down the centre of each bay, the metalwork of the fittings being real bronze and the glassware the well-known G.E.C. "Verilux"—a triplex glass embodying a layer of bluish glass, which absorbs the excess of red and yellow rays, giving an illumination very similar to daylight in composition. Each of these fittings is equipped with a 300-watt "Osram" gasfilled lamp, and the very fine illumination resulting therefrom is shown in the illustrations. In particular, the rich colourings of the carpets shown in Fig. 1, and of the fruit and vegetable display in Fig. 2, are very noticeable.

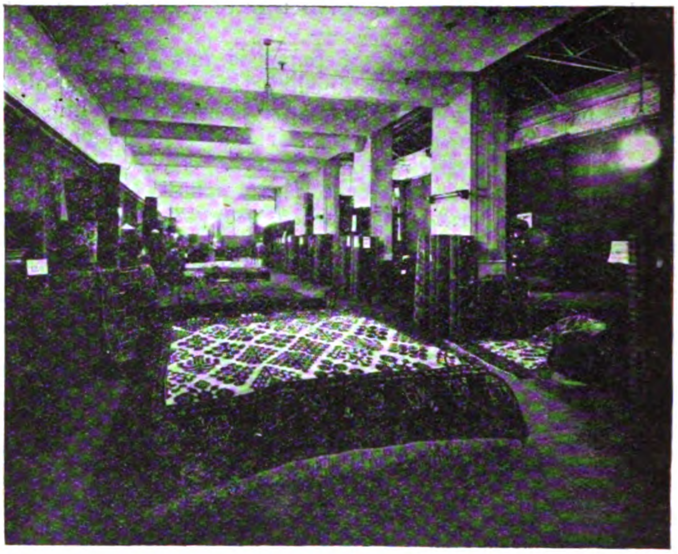


FIG. 1.

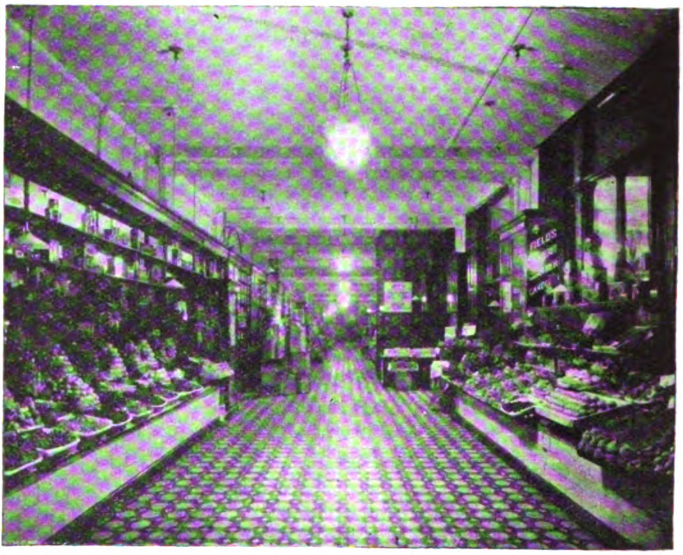


FIG. 2.

"Osram" lamps are also utilised for the whole of the exterior lighting of the Queen's Road premises by means of a row of no fewer than 900 60-watt gasfilled lamps fitted along the cornice above the window, making an extremely effective display. In addition, a large sign on the dome consists of a border of apricot colour-sprayed "Osram" gasfilled lamps, the word "Whiteley's" being picked out in daylight blue lamps.

TELEPHONY.*

Being solutions to questions selected from the Telephony, Grade I., Examination, held by the City and Guilds of London Institute on May 3, 1923.

(*Continued from page 162.*)

Q.—Upon what does the resistance of a wire depend? A block of metal measures 2 inches by 1 inch by 1 inch; its opposite sides and ends are parallel, and its angles are right angles. Compare the resistance of the block when measured between the ends, which are 2 inches apart, with the resistance measured between two opposite sides. Would the resistance between the ends be the same if the parallel ends did not make right angles with two of the sides?

A.—The resistance of any piece of metal of uniform cross-section depends on its specific resistance (or resistivity), its length, and its cross-section, or

$$R = k\frac{l}{A} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

where R is the resistance in ohms, k the specific resistance expressed in ohms per cubic inch or per cubic centimetre, and A the cross-section in square inches or square centimetres.

Let r_1 be the resistance of one cubic inch of the metal in question when the resistance is measured between any two opposite faces, then the resistance R_1 of the block 2 inches by 1 inch by 1 inch when measured between the *ends* will be

$$R_1 = 2r_1.$$

When the resistance R_2 is measured between any two opposite sides

$$R_2 = \frac{r_1}{2}$$

Whence

$$\frac{R_1}{R_2} = \frac{2r_1}{\frac{r_1}{2}} = \frac{4}{1}$$

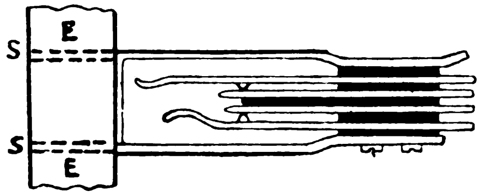
or the resistance in the first case is four times that in the second case.

If the parallel ends of the block did not make right angles with any two of the sides, and if the cubical content of the block remained the same, the cross-section of the block would necessarily be reduced, and by equation (1) above the resistance would be increased.

Q.—Sketch and describe the type of jack used on private branch exchange switchboards, and indicate in what respect it differs from the jack use in large public exchanges of the common battery type.

A.—The jack used on private branch exchange switchboards is of the 5-point type (see figure). It consists of four springs, the fifth point being the socket *S S*. The springs are made of German silver and are insulated from one another by strips of ebonite, *E E*, the socket being of brass. The contact points are of silver-gold alloy (90 parts of silver to 10 of gold). Normally the inner pair of springs make contact with the outer pair, but when a plug is inserted in the jack the tip and ring of the plug are connected to the outer springs and the inner pair are disconnected.

The jack used on common battery switchboards is of the 3-point type. It consists of two springs and a socket. The tongues of the springs both face the same way, *i.e.*, the springs bear on the plug on the same side, and not on both sides of the plug as is the case with the 5-point jack. It is argued that this construction ensures better contact between jack and plug.



(*To be continued.*)

---

* Books recommended are *Questions and Solutions in Telegraphy and Telephony, Grade I.*, by Few (Rentell, 5s 10d. post free), and *Practical Telephone Handbook*, by Poole (Rentell, 15s. 6d. post free).

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 179.

Can any reader give me the technical details of the "Z" connection of instrument transformers used on E.H.T. 3-phase feeder indicator and trip coil circuits? What are the advantages of this type of connection over the ordinary star connection?—"F. B."

(*Replies to Question No. 179 must be received not later than April 26, 1924.*)

Personal.—Mr. Geo. C. Usher, general manager and director of Vickers and International Combustion Engineering, Ltd., has sailed for U.S.A. to consult with the directors of the International Combustion Engineering Corporation of New York City. He will also make a tour of inspection of the more recent electric power stations which the company has equipped with Lopulco pulverised fuel plant. He expects to return in about six weeks.——Mr. David Wilson, O.B.E., for many years on the staff of the B. and W. Co., has recently joined the same company, and will visit the U.S.A., where he will make a close investigation of the working details of principal pulverised fuel plants in that country and Canada.——Mr. E. Kilburn Scott, M.I.E.E., A.M.Inst.C.E., has charge of the publicity department of the company, and assists with the sales engineering. They have an exhibit on Stand 2 of Vickers, Ltd., at the British Empire Exhibition, Avenues 7 and 8, Bay 9.

Various Items.

Removal.—The Vickers and International Combustion Engineering, Ltd., has removed from 4, Central Buildings, Westminster, to Africa House (Fifth Floor), Kingsway, W.C.2.

Presentation.—The Faraday Medal of the Inst. E.E. will be presented to Dr. S. Z. de Ferranti on Thursday, April 24, at 6 p.m., on which date Mr. G. Semenza, of Milan, will deliver the fifteenth Kelvin Lecture, and will take as his subject "Kelvin and the Economics of the Generation and Distribution of Electrical Energy."

Pumping.—A standard reference work on "The Modern Theory and Practice of Pumping" is to be published shortly by Ernest Benn, Ltd., at 43s. Written by Mr. Norman Swindin, A.M.I.Mech.E., it is a comprehensive story of viscosity from an industrial point of view, and a description of industrial viscometers, their standardisation, calibration and use.

E.D.A. and the B.E.X.—The E.D.A. section at Wembley will undoubtedly be one of the chief centres of attraction in the Palace of Engineering, and for this much credit is due to the architects, Messrs. Imrie and Angell, 2, Mitre Court Chambers, Fleet Street, E.C.4, who have been responsible for the design of the structures and other decoration, and given very valuable assistance with regard to furniture, the arrangement of lighting, choice of fittings, etc. They have also been responsible for the design and architectural work on the stands of the Cable Makers' Association, Messrs. Edison Swan, and the British Electric Transformer Co.

Congratulations to the members of the Diesel Engine Users' Association on the kindly spirit which prompted them on March 28 last to give a handsome and suitably engraved gold watch and chain to the hon. secretary, Mr. Percy Still, as an appreciation of his ten years' service. Prior to the presentation, Mr. Still had been entertained at luncheon at the Coventry Restaurant and, in proposing the toast of their guest, Mr. A. W. A. Chivers, the president of the Association, spoke feelingly of the high respect and affection felt for Mr. Still by all the members, and laid stress on the organising ability which had enabled him to raise the Association to its present high standard. Mr. Still acknowledged the gift in a most charming speech, in which he quoted the motto engraved on the watch, and recommended it as a guide to all present. He also referred to the many friendships he had formed among Diesel Engine Users during the past ten years, and concluded with the remark that he regarded the occasion as one of those happy events that serve as beacons down the passage of time.

I.E.E. Wireless Section Committee, 1924-25.—The following have been nominated to serve on the Wireless Section Committee of the Institute from October 1, 1924:—Chairman, E. H. Shaughnessy, O.B.E.; ordinary members, Prof. C. L. Fortescue, Capt. N. Lea, B.Sc., C. F. Phillips, and Comdr. J. A. Slee, C.B.E. The following will continue to serve as members of the Committee:—The President, I.E.E., the chairman of the Papers Ctee., a nominee of the Council, a nominee of the G.P. Ctee., S. Bryden, D.Sc., C. F. Elwell, Prof. G. W. O. Howe, D.Sc., Admiral Sir H. B. Jackson, G.C.B., F.R.S., J. St. Vincent Pletts, Capt. H. R. Sankey, C.B., C.B.E., R.E., R. L. Smith-Rose, Ph.D., M.Sc., C. F. Trippe, together with Maj. R. Chenevix-Trench, O.B.E., M.C. (nominated by the War Office), Capt. C. E. Kennedy-Purvis, R.N. (nominated by the Admiralty), Maj. A. G. Lee, M.C. (nominated by the Post Office), and Maj. H. P. T. Lefroy, D.S.O., M.C. (nominated by the Air Ministry).

Trade Notes.

A bright and attractive showcard illustrating the various types of Radiola wireless sets now being placed on the market by the **B.T.-H. Co., Ltd.**, has been issued by the company's publicity department at Crown House, Aldwych, London, W.C.2, and can be obtained from them on application. It should be a good means of assisting trade in these goods, and we can therefore recommend it to all dealers in wireless supplies as likely to attract attention.

An attractive circular *re* "Ship" projection carbons has been issued by **Messrs. E. A. Langrish and Co.**, of 26/7, D'Albray Street, London, W.1, who claim that they have large stocks in hand, and that the carbons themselves can be recommended as of excellent quality for cinema work. This announcement should interest picture-palace electricians in all parts of the kingdom.

A leaflet describing the Enox Cable Cutting Hacksaw Blades has been issued by **Fry's (London), Ltd.**, engineers' tools manufacturers, of 46, Upper Thames Street, London, E.C.4. These blades are made in two types, namely, "T" for cutting tape armoured cable, and "W" for cutting wire armoured cable. They should, we think, find a ready market among central station engineers and installation contractors generally, and we recommend application for copies of the list, mentioning this notice.

Constable's monthly list of books has just been issued, and will prove of interest to quite a number of our readers, dealing as it does with all sorts of literature, including several new technical books on such subjects as pressure gauges, pattern making and moulding, all of which are being added to their series of "Practical Manuals for Practical Men." Readers should write to them for copies of the circular, or if at Wembley should call at the stand of **S. Rentell and Co., Ltd.**, Avenue 15, Bay 14, where these and other technical books published by Messrs. Constable are on sale.

We are in receipt of several circulars from the **Metropolitan-Vickers Electrical Co., Ltd.**, describing choke coils, oil drying and purifying equipment, single-phase power transformers, three-phase power transformers, and potential transformers. These circulars are produced in this firm's usual excellent manner, and they contain a lot of valuable information—in fact, they may be termed miniature text-books, and are well worth reading by engineers, etc., who are interested in the subjects concerned. A collection of these circulars should be on the files of every electrical engineer.

A new Radio catalogue has just been issued by the **Economic Electric Co., Ltd.**, of 10, Fitzroy Square, London, W.1. It contains 40 pages of illustrations, prices and data dealing with the very large assortment of wireless sets and accessories which are supplied by this well-known company, and should therefore prove of direct interest to a wide circle of our readers. Our advice to them, therefore, is to make early application for copies, which will be sent free on request.

GRINDERS
DRILLS
"DEPENDABLE"
& POLISHING LATHES
MARRYAT & PLACE, ENGINEERS.
28 HATTON GARDEN, E.C.2.

REGD. Vulmos GENUINE VULCANIZED FIBRE
MOSSES & MITCHELL, LTD. 122 & 124 GOLDEN LANE LONDON, E.C.

Sample Pair Sent on Approval for 8/6
Made of Pure Para Rubber, soft and durable and unaffected by climatic conditions
DAVID MOSELEY & SONS
Limited.
ARDWICK MANCHESTER
MOSELEY RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
A PRACTICAL TRADE JOURNAL

APRIL 25, 1924.

CONTENTS. PAGE

Air-Break Control Gear for Small A.C. Motors 209
Telephony (Solutions) 210
Development of the Bellini-Tosi System of Direction Finding in the British Mercantile Marine 211
The Testing of Multicore Telephone Cables for Out-of-Balance Capacity 213
Questions and Answers by Practical Men 214
Current Topics 217
Westinghouse Dual Frequency Super-Calender Drive .. 219
Preston Illuminated Tramcar 220
Electric Driving of a Modern Factory 221
Correspondence 222
Cinema Lighting 222
Water-Tube Boilers 223
Various Items 224

AIR-BREAK CONTROL GEAR FOR SMALL A.C. MOTORS.

(Concluded from page 199.)

TYPICAL AIR-BREAK STAR-DELTA PANEL.

When star-delta starting is required the gear adopted often consists of a suitable starter fitted with the ubiquitous fuses. This type of gear has the objection that the fuses may "blow" when starting up, and considerable time be lost in replacing them. A far better arrangement is the combination of breaker and starter, with full automatic releases, which, having a high short-circuit breaking capacity, offers sure protection for the motor under any conditions of service. Further, should the breaker trip when starting up, it can be re-closed immediately without risk to the most unskilled operator. A typical panel of this description, consisting of a circuit breaker of the "Mill" type previously described, together with a drum-type star-delta starter, is shown in Fig. 2. This is the simplest, safest and most complete form of air-break control panel for use with S.C. motors when the starting current must be kept low and a high starting torque is not required.

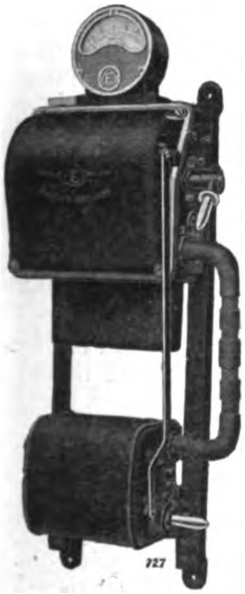


FIG. 2.

The circuit breaker has already been fully described, and needs very little further comment. It is of the totally enclosed magnetic blow-out type, and is fitted with automatic releases and time lags. These automatic releases are in circuit in both "start" and "run" positions, and this alone constitutes a great advantage over the fuse and starter equipment, where the fuses are usually cut out during the starting period. The reason for cutting the fuses out during starting is that the starting current being so much larger than the normal running current, if the fuses were in circuit during "start" they would need to be large enough to carry the full starting current, and consequently would be less effective in protecting the motors against overloads. In the case of the breaker and starter panel, however, by fitting time lags to the overload releases they are prevented from operating on the peak currents at start, and so can be left in circuit during starting, although set to trip at normal overloads and short circuit. A strong mechanical interlock of simple design is fitted between the breaker and starter to release the starter to the "off" position when the breaker is open.

The starters are of the drum type, with renewable contact fingers and segments. All live parts are enclosed in cast-iron cases, with sheet-iron covers, which are sufficiently dust-tight for factories, but not for collieries, gasworks, and other places where the atmosphere is charged with coal dust or noxious fumes. The drum must be held in the starting position against the pressure of a strong spiral spring which returns it to the "off" position when the handle is released, while it is held securely in the "on" position until released either by hand or automatically. A correct sequence device is also fitted requiring that the contacts must be completely home in the "starting" position before the handle can be moved to the "running" position, and that a quick change over is made from one position to the other.

It is also interesting to note that the "off" position is located between the "start" and "run" positions, so that in breaking from "run" the contacts pass directly to "off." Although of little importance when the starter is protected by a separate breaker, the reason is obvious. Starters which pass through "start" to "off" suffer from extra wear of the contacts, and may be very dangerous when fitted with overload coils and the release is due to a short circuit. Such starters first break the short on the "run" contacts, then make and break it again on the "start" contacts. No one would think of buying a circuit breaker which re-made the fault it has just interrupted, yet starter-breakers with this defect are sometimes accepted even to-day.

The series-parallel starter is similar to the star-delta starter.

CONTROL OF SLIP-RING INDUCTION MOTORS.

So far we have dealt only with S.C. motors, but for some duties such motors are not suitable. When large starting torque is required, or where the starting current must be kept very low, a motor having a wound rotor is used. We have already discussed several methods of reducing the current rush when starting induction motors, and they have all consisted of some kind of stator control. In addition to these, however, a similar effect can be obtained by the insertion of resistance in the secondary, or rotor, circuit. Not only does this method reduce the starting current, but it also increases the starting torque. In fact, it is possible to introduce sufficient resistance into the rotor circuit to make the motor start with full load torque and normal full load current. Unfortunately, this additional resistance causes an excessive secondary copper loss, and to ensure that this may continue only while the motor is starting, the resistance must be arranged so that it can be cut out as the motor comes up to speed. This necessitates the fitting of slip-rings to the rotor and sacrifices to some extent the simplicity of the S.C. construction.

To control a slip-ring motor, therefore, it is necessary to provide some means of connecting the stator circuit to the supply, and an arrangement for gradually cutting out the additional rotor resistance as the motor speeds up. Here again air-break gear can be used and certainly should be used in all cases where the output of the motor does not exceed 40 to 50 h.p. A typical panel consisting of a circuit breaker and rotor starter is shown in Fig. 3, the circuit breaker being of the "Mill" type already described. The whole of the gear is dust and weather-proof and is suitable for use in the open and in workshops, mills, factories, gasworks, and collieries where gas is not present. It is not explosion-proof, but fulfils all the requirements of the Home Office regulations and the Mining and Factory Acts. The breaker and starter are mechanically interlocked by a strong simple device which acts to return the starter to the "off" position when the circuit breaker is open.

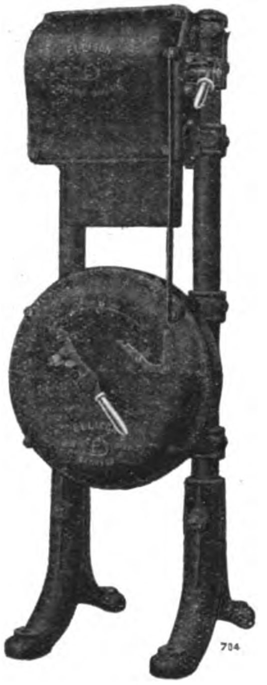


Fig. 3.

The rotor starter is of the self-contained type, the starter and resistance both being mounted in the same circular iron casting fitted with a domed iron casting for a cover. This cover carries on the exterior the operating handle, pointer and retaining hook, and on the interior a slotted driving arm which engages with the brush spider, and a powerful spring which returns the brush contacts to the "off" position. The fixed contacts are mounted on a substantial slate base, the complete dial being fixed on a cast-iron spider which also carries the resistance elements. The spider is secured to the case by three screws, and when these are removed the starter, complete with dial, resistance connections, terminals and moving contacts can be removed from the case. By this means erection, inspection and repair are greatly facilitated, as the case can remain bolted to its supports with cable fittings undisturbed, while the whole interior is removed as a single unit. The resistance elements consist of a wire of high resistance alloy with negligible temperature co-efficient, wound on strong threaded stoneware cylinders which support the wire throughout its length and effectively prevent short circuits from turn to turn.

Faraday House O.S.A.—Old students are reminded that the annual smoking concert will be held at the Hotel Cecil (Prince's Hall) on Friday, May 2, at 8 p.m., with the president, Mr. R. N. Vyvyan, M.I.E.E., in the chair. Accommodation will be available for 300, and a first-class musical programme has been arranged.

TELEPHONY.*

Being solutions to questions selected from the Telephony, Grade I., Examination, held by the City and Guilds of London Institute on May 3, 1923.

(*Continued from page* 207.)

Q.— Sketch and describe the indicator used for calling purposes on extensions on common battery private branch exchange switchboards.

A.—The indicator used for calling purposes on extensions on common battery private branch exchange switchboards is of the "eyeball" type (see

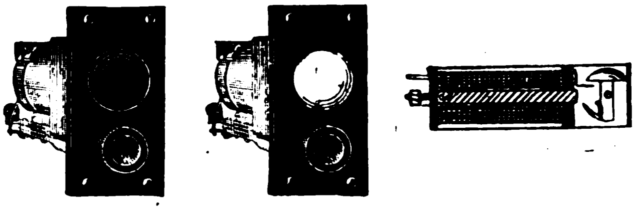


figure). It consists of a single electromagnet in front of which a dome-shaped signal or target, attached to a curved soft iron armature, swings on a spindle. A current in the coil attracts the curved soft iron armature, and the target, which is usually painted white or coloured, closes the aperture. When the current ceases, the tongue acts as a counterpoise and the armature and target are restored to the normal position.

One type of eyeball indicator is wound to a resistance of 500 ohms and requires 9 milliamperes to operate it; another is wound to 1,000 ohms and requires a current of 7½ milliamperes to operate it.

Q.— Describe the process of making a joint between two lengths of a main cable intended for the service of subscribers.

A.— The operation of jointing conductors of 70-lb. gauge and over in a multiple twin cable is as follows:—

The lead sheathing is cut off the ends of both cables for the required distance and is trimmed carefully. A lead sleeve, about 2 feet long, and of slightly larger internal diameter than the cable sheath, is slipped on the end of one of the cables.

The conductors are stripped of the paper insulation for a distance of 1 inch on one side, and for 3 inches on the other side, and tinned copper jointing sleeves of the proper gauge are slipped back over the conductors.

Jointing is commenced with the middle pair of the lower half of the outside layer, care being taken to connect wires having paper insulation or thread of the same colour. Each conductor is cleaned and tinned carefully, and the copper sleeves are then drawn back over the ends of the conductors and soldered. In order that a "bunch" may not be formed at any point the joints are spread evenly over the available space. One of the paper wrappings is replaced over the joint, and the other wrapping is wound over the first, and tied with thread. In jointing 40-lb. and lighter conductors the two wires, with the paper insulation still on them, are given three or four twists in a length of about ½ inch. The paper is then removed, the conductors cleaned and twisted to a length of about 1¼ inches, the surplus wire being cut away. The paper sleeve is then slipped over the joint. When all the wires have been joined, the whole arrangement is dried by means of charcoal braziers, care being taken not to carbonise the paper insulation. A final paper wrapping is then given to the joint, and the lead sleeve is drawn back. A wiped joint is then made by a qualified plumber.

---

* Books recommended are *Questions and Solutions in Telegraphy and Telephony, Grade I.*, by Few (Rentell, 5s 10d. post free), and *Practical Telephone Handbook*, by Poole (Rentell, 15s. 6d. post free).

The tests to which an air-space cable is subjected are:—

(1) For continuity of the wires.
(2) For freedom from contact.
(3) For ascertaining conductor resistance and insulation resistance.
(4) To prove the plumber's work.
(5) For correct jointing.
(6) Overhearing.

(*To be continued.*)

DEVELOPMENT OF THE BELLINI-TOSI SYSTEM OF DIRECTION FINDING IN THE BRITISH MERCANTILE MARINE.*

By COM. J. A. SLEE, C.B.E., R.N. (Ret.), Member.

(*Continued from page 200.*)

The causes of lack of symmetry are twofold: "Permanent" lack of symmetry due to unequal distribution of any electrical dimensions between the two sides of a loop, which would result in unequal impedance in the two halves, measured from apex to mid-point; and "inductive" lack of symmetry due to re-radiation and/or induction from individual conducting portions of the ship's structure, which may have unequal effects upon the two halves of a loop. The effects of the former are apparent, irrespective of the strength of signals, but the effects of the latter increase with the strength of signals, and are often only noticeable with very strong signals. This state of affairs appears to be explained as follows:—

Consider an athwartship loop which is inductively unsymmetrical, the relative bearing being considered to be right ahead. There is zero loop current in this loop, but the effect of inductive lack of symmetry is to cause an unequal distribution of plain current between its two halves, and, therefore, there is a magnetic coupling between the field coil and the search coil. The effects of this current may be too slight to deflect the resultant magnetic field through the field coils to any appreciable extent, and no error is then observable, but when the effect of the inductive lack of symmetry becomes sufficient to deflect the resultant magnetic field through the field coils the error begins to appear. There is, in short, a marked threshold effect observable in cases of inductive lack of symmetry. In cases of permanent lack of symmetry, the disturbance due to unequal distribution of plain current increases in the same proportion as the loop current, being due directly to the plain voltage and not to the effects of an outside conductor itself under the influence of the wave, and no threshold effect is observed. Inductive lack of symmetry is the source of the most elusive and the most dangerous errors which have been experienced in the application of direction finding to navigation.

Having decided on the position of the loops, the next point is to decide on their form. This is a matter of but very little importance provided that extremes are avoided, but it is very desirable that there should be a pronounced geometrical apex to each loop. For sea-going work it is essential that the thwartship loop should have a well-marked apex, and it is advisable that the fore-and-aft loop should have one also. The reason is simple. Consider a flat-topped thwartship loop. If the vessel is on an even keel the top of the loop is horizontal and the electrical apex is in the centre of the horizontal limb. If now the ship heels over, even to a very small angle, the apex becomes the weather corner and symmetry is destroyed. The same applies, but in a less degree, to the fore-and-aft loop.

Lack-of-symmetry error is the only error which can make a bearing appear to be in the wrong quadrant, and lack of symmetry in the thwartship loop may well be sufficient to make a bearing appear to be on the wrong bow.

If it can be assumed that the loops are symmetrically rigged truly fore and aft and athwartships, and with the geometric axis of each loop directly over the point where the ends of the loop join its cable, and that they can be kept taut, then the possibiltiy of errors due to lack of symmetry is reduced to a minimum; and as permanent lack of symmetry can be detected by easily applied internal tests of sufficient delicacy, the actual danger due to lack of symmetry in all its forms is zero.

Lack-of-symmetry error takes many forms according to its extent, and whether one or both loops are at fault. The strange diversity of results is hardly worth recording now that symmetry testing has been established, but it is worth noting that a combination of a slight lack-of-symmetry error and a slight electrostatic error often has the effect of leaving one zero accurate and sharp and the other very "woolly." It is sometimes necessary to acept this as a temporary measure, and to let well alone.

(*d*) *Plain tuning error.*—The remaining inherent error is due to the effects caused by the frequency of one loop, viewed as a simple plain aerial, being very nearly in tune with the incoming wave when the frequency of the other loop is somewhat less nearly in tune. This error is comparable with loop-tuning error and is negligible if loops of proper dimensions are used. The adoption of the inductive choke mentioned in the preceding paragraph renders the loops viewed as "plain" aerials practically aperiodic (in the true sense of the word) and is now almost unheard of. The effects are zero if perfect symmetry exists; if not, it accentuates the lack-of-symmetry error on certain waves. It is generally called "plain tuning error."

(*e*) *Electrostatic error.*—There are also two inherent instrumental errors. Of these the more important is the result of superposing the stray capacity coupling between the field coils and the search coil upon the magnetic coupling. The effect of this stray capacity coupling is to distort both positions of zero resultant coupling, and, although the line bisecting the angle between the observed zeros is at right angles to the proper zero due to magnetic coupling only, the presence of this error is detrimental to rapid and accurate work. It can be practically annihilated by the interposition of an earthed shield between the windings of the transformer connecting the search coil with the tuning condenser. It is most noticeable when the stray capacity is large in proportion to the tuning capacity, that is to say, on the shorter waves, when the tuning capacity is very small. This is commonly called the electrostatic error.

---

* Paper read before the I.E.E.

(*f*) *Capacity error.*—The second instrumental error is due to the varying capacity coupling between the search coil and first one and then the other of the field coils. By spreading out the windings of the search coil on one side of its former in a V shape, this error, which is never as much as 1 deg., can be made to reach its maximum and fall to zero eight times in the 360 deg., and, so long as "swing" readings are used, it is truly negligible, and in practice no notice is taken of it. This is the cause of the important difference in practical working between systems employing "tuned" and "untuned" loops. In the former case the arc through which the search coil can be moved, while still preserving inaudibility of a naturally good signal, is very small—perhaps only 2 deg. to 3 deg.—and under these conditions what are familiarly known as "sitting" readings can be taken. In the latter case the arc of inaudibility is usually 20 deg. to 40 deg. and "sitting" readings are impossible; only swing readings can be used, and these of necessity eliminate the second instrumental error.

The colloquial term "swing readings" means observing the position of the pointer which gives equal strength of signals on either side of the arc of inaudibility, and taking the mean of these two positions as the position of true zero. It is usual to observe the position in which the signal just becomes inaudible. Bearings are perfectly reliable with vanishing points up to 60 deg. apart.

(3) CONSTRUCTION OF LOOPS.

From the foregoing it is clear that, given a properly constructed direction-finder, everything depends upon the erection of electrically symmetrical loops of the correct relative areas, the planes of the loops being necessarily vertical and at right angles to one another. One must be exactly fore and aft and the other exactly athwartships, but there is no reason why their planes should intersect, and no practical disadvantage is found if they do not do so, so long as the distance between their axes is small in comparison with a quarter wavelength.

It should be noted that there is no obvious theoretical reason why the fore-and-aft loop should be on the centre line of the ship, though common-sense indicates that it is desirable to place it there. No experiments have been tried with fore-and-aft loops out of the centre line, as every effort has been concentrated on producing a seamanlike and trustworthy aid to navigation, and no opportunity has offered for academic investigation. One fore-and-aft loop accidentally fitted a little off the centre line gave indifferent results.

Under ordinary sea-going conditions a subsidiary difficulty is experienced. If the loops cannot be made permanent, but have to be lowered and re-hoisted frequently, there is a great likelihood of the symmetry being destroyed in the process. This has been found to be a very real and serious cause of trouble.

Summarising the above, it is clear that the main practical difficulty lies in the selection of a suitable position for the loops and in the appropriate arrangements for rigging them. Before selecting the position of the loops it is first necessary to decide on the position of the direction-finding instrument. As far as the mercantile marine is concerned, it is highly desirable to have the instrument in the wireless room. It should be under the charge of the telegraphist and always available for practice, and when using it he should be in his own place and not an intruder among the navigating staff. The position of the direction-finding instrument must to some extent limit the choice of positions for the loops, on account of the capacity of the connecting leads.

For this purpose twin lead-covered paper-insulated cable is used, the cores each consisting of one strand of 20.L.S.G. copper, and with this cable a total length of 100 ft. is permissible from the direction-finder to the commencement of the loops. This figure is based on the assumption that the loops are to be large enough to allow good bearings to be obtained up to a distance of 100 miles on spark waves between 400 and 1,000 m., and small enough to avoid "loop-tuning" error on 400 m.

Experience shows that the larger the ship the larger should the loops be for a high degree of accuracy. Small loops, even down to an area of 70 sq. ft., have given accurate service at ranges up to 30 miles in small ships, though they are not accurate in large ships. The reason for this appears to be best explained if the state of the electric field among the rigging, funnel, boat gear, etc., of a large ship be regarded as a mass of eddies, in which loops large in proportion to their surroundings are affected by many such eddies tending to balance one another and thus give an accurate average result, whereas loops small in comparison with their surroundings are more likely to feel the effect of a single eddy and thus give inaccurate bearings.

Experience has shown that loops work well for all frequencies lower than their own natural frequency, but they are very unsatisfactory for frequencies higher than their own. Obviously, the capacity from core to core of the lead-covered cables is a very important factor in determining the "loop" frequency of each aerial, and the capacity from cores to lead covering is of similar importance in determining the "plain" frequency of each aerial. The core-to-core capacity also acts as a shunt to the field coils, and, briefly speaking, the shorter the cables the better are the results.

Having complied with the limits imposed by the permissible length of cable, a search must be made for some place where the loops can be erected and in which it will not be necessary to lower them. For work under mercantile marine conditions as outlined above (400 to 1,000 m. spark), the area of the loops should lie between 200 and 400 sq. ft.

No part of the loop should come within 6 ft. of earthed metal, and if the disposition of such earthed metal is not symmetrical about the axis of the loop, this distance must be increased to at least 12 ft. This figure is not yet definitely fixed, but there is clear evidence of evil effects at distances up to 10 ft., and it is quite possible that the safe distance may be as great as 20 ft.

If unsymmetrical objects, such as ventilators or hatches, are unavoidable, they must be screened by the interposition of an earthed plane—say, wires 1 ft. apart—at least 6 ft. wide and symmetrically disposed on each side of the axis of the loop which it is intended to shield. Satisfactory results are obtained if the screen is mid-way between the nearest limb of the loop and the object from which it is to be shielded. If these precautions are neglected, evanescent errors may occur due to, for instance, the opening and shutting of large iron skylights, turning of ventilators, etc.

(*To be continued.*)

THE TESTING OF MULTI-CORE TELEPHONE CABLES FOR OUT-OF-BALANCE CAPACITY.*

By F. P. PYE (*Faradian*).

An ordinary telephone circuit consists of a pair of wires across which the instruments are connected as shown in Fig. 1.

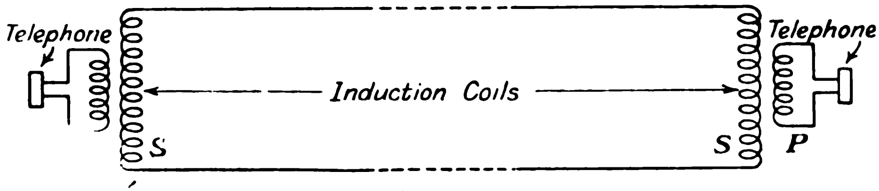


FIG. 1.

In the "Multi-Twin" type of telephone cable, which is now exclusively used for trunk telephone lines in this country, the cores are made up into two sets of "pairs," this combination being called a "quad." The instruments are now connected as shown in Fig. 2.

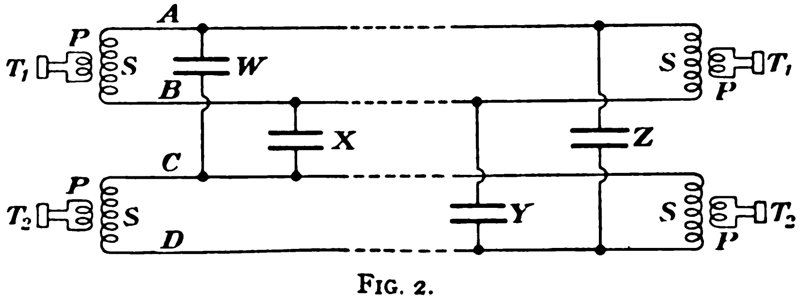


FIG. 2.

Thus four wires are required to carry the two telephone circuits.

Some time ago the theory of the phantom telephone circuit was investigated, and it may be shown mathematically that if the capacities (electrostatic) are made equal, or as nearly so as possible (by making up the quad of copper wires having their physical and electrical properties as nearly symmetrical as is practicable), then another circuit may be superimposed upon the two existing circuits, as shown in Fig. 3, thus giving three circuits on four wires.

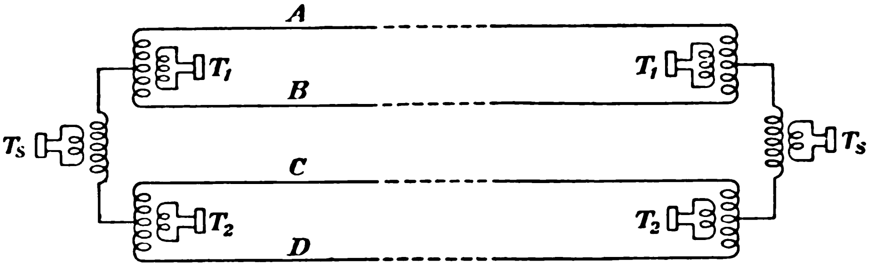


FIG. 3.
T_1T_1 and T_2T_2 = Ordinary circuits. T_sT_s = Phantom circuit, using *A*, *B* and *C*, *D* together.

It is essential that the out-of-balance capacities in the cores be kept as low as possible, otherwise we shall have what is known as "cross-talk" occurring—*i.e.*, a person listening on any circuit could overhear a person speaking on any of the other circuits, and vice versa.

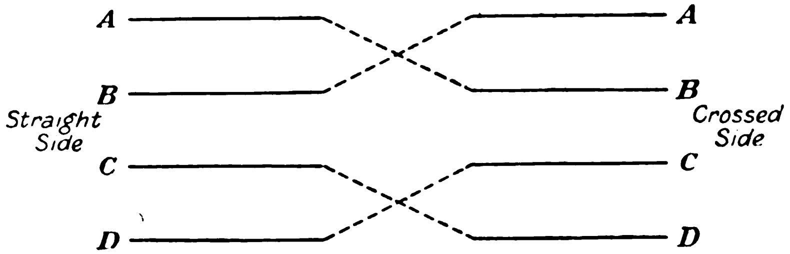


FIG. 4.
BOTH *A B* PAIR AND *C D* PAIR ARE CROSSED.

Consequently telephone cables are tested after being made for out-of-balance capacities, and from the results of these tests the joints between lengths are selected.

In a selected joint the wires of a quad at the end of one length are crossed over before being joined to the wires of the quad at the beginning of the next length, an example of this is shown in Fig. 4. In this case the wires in each pair are crossed over, but this is only one of the eight types of crosses which may be put in.

It is difficult to explain exactly how these crosses affect the out-of-balance capacities, but actually the operation of putting a cross on any quad changes the signs of various figures in the test results, so that when combined with a quad on an adjacent length the resultant figures are as low as possible. This process of selection is commonly known as "wangling," and the word really describes the process very well.

The testing set used in these tests is in the form of a Wheatstone Bridge, only it has variable condensers in the sides instead of ratio arms.

A diagram of the set is given in Fig. 5.

The condenser C_W gives the out-of-balance wire-to-wire capacity in *micro-microfarads*, and C_E gives the out-of-balance wire-to-earth capacity in the same units.

The four wires in the quad are connected on to the set by means of a selector switch, which has four positions, which are called "p," "q," "r," and "s."

In position "p" the capacity is taken between *A*, *B* and *C*, with *D* earthed.

---

* From the *Faraday House Journal*.

In position "q" the capacity is taken between A, B and D, with C earthed.

In position "r" the capacity is taken between C, D and A, with B earthed.

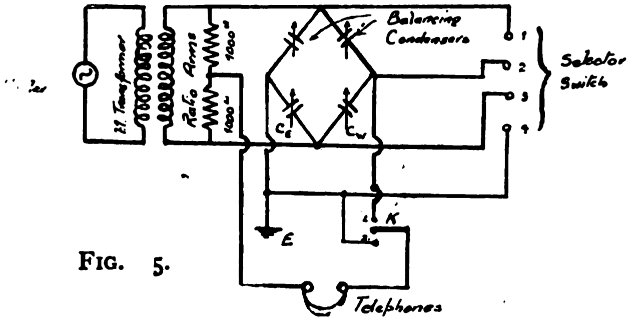


FIG. 5.

In position "s" the capacity is taken between C, D and B, with A earthed. These connections are shown in Fig. 6.

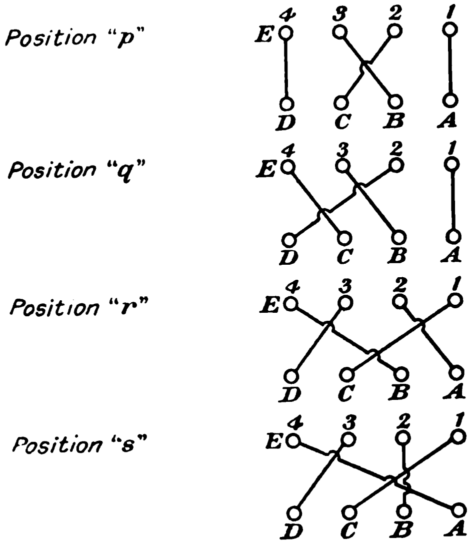


FIG. 6.

The "howler" shown in Fig. 5 takes various forms such as a reed hummer or valve oscillator.

Its function is to produce A.C. for the bridge, of an audible frequency. When the bridge is imperfectly balanced a note is heard in the headphones, balance being indicated, of course, when this note ceases.

To operate the set the selector switch is moved to position "p," the key K is then pressed down to position 1 and C_W is adjusted, so that silence is obtained in the telephones, then K is allowed to come up to position 2, and C_E is also adjusted to give silence. The readings of the two condensers are then noted.

Similar operations are performed for the positions "q," "r" and "s" of the selector switch.

From these figures the characteristic of each quad is worked out as shown below:—

	W to W	P–Q	$P+Q$	W to E	E
"p"	5	3	7	–10	–12
"q"	2	..	..	– 7	–12
"r"	2	3	1	–18	–17
"s"	–1	..	..	–15	–17
	(1)	(2)	(3)	(4)	(5)

Columns (1) and (4) are those read out by the operator as the readings on C_W and C_E. The other figures are worked out by the person who is writing down whilst the operator is obtaining the next set of condenser readings.

In order to obtain the figures in column (5) the W to W reading for "q" is subtracted algebraically from the W to E reading of "p." Similarly the W to W reading for "p" is subtracted algebraically from the W to E reading of "q."

Similar operations are performed on "r" and "s."

The two $(P–Q)$ readings should be the same, or within one figure, and also the two earth readings for any pair.

The characteristic of any quad consists of—

	$(P–Q)$	$(P+Q)$	$(R+S)$	E_{ab}	E_{cd}
i.e.,	+3	+7	+1	–12	–17

It should be noted that when the "earth" is referred to in this article it means the lead sheath of the cable.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION No. 179.

Can any reader give me the technical details of the "Z" connection of instrument transformers used on E.H.T. 3-phase feeder indicator and trip coil circuits? What are the advantages of this type of connection over the ordinary star connection?—"F. B."

(Replies to Question No. 179 must be received not later than April 26, 1924.)

Electric Lifts.—A meeting of the Birmingham Electric Club will be held at the Grand Hotel, Colmore Row, on Friday, 25th inst., at 7 p.m., when a lecture will be given on "Electric Lifts," by Mr. C. A. Munson (of the Express Lift Co., Ltd., London). It will be illustrated by lantern slides, and some interesting particulars will be given of the lift requirements of tall buildings in America, where lift speeds of 800 ft. per minute are used.

Quotations Wanted.—The Saint Gilles Municipality, Belgium, invite tenders for the supply of armoured cables.——The port authorities in Montevideo invite tenders for the supply, delivery and erection of one electric winch capable of hauling boats of 600 metric tons, and two electric capstans of a hauling capacity of 8 metric tons, at a circumferential speed of 10 to 15 metres per minute.——The Public Works Dept., Wellington, N.Z., invite tenders for 12 electric ranges for the Mangahao Power Scheme (Section 122).——The Municipal Council of Johannesburg invite tenders for three rotary converters.——The Municipal Council of Johannesburg invite tenders for a motor converter.——The Public Works Dept., Wellington, N.Z., invite tenders for oil switches, together with relays and current transformers, for Lake Coleridge Electric River Scheme (Section 151).—Specifications, etc., at the D.O.T. (Room 52), 35, Old Queen Street, S.W.1.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of
CORRECT ARTIFICIAL LIGHTING

Advert of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

Wembley. By the time these lines are in print a good many of my readers will have visited the British Empire Exhibition, and have realised how necessary it will be for them to go again and yet again, and spending, if possible, whole days in the process if they hope to see everything of interest in the Engineering Section alone, and quite apart from Industry, or the Dominion exhibits. At the time of writing I have spent upwards of a week at Wembley, including the Easter vacation, doing my bit towards getting all in readiness for the formal opening on St. George's Day, and it has been remarkable to note the energy which everyone responsible for making the send-off as great a success as possible has put into the gigantic task. All worked with a will, and there was no sign last week of the strike spirit inspired earlier in the proceedings by the Moscow gentleman with the megaphone.

There have been oversights and handicaps to contend with, of course; a tremendous undertaking of this character must inevitably entail a hitch here and there in the otherwise smooth progress of development. A minor difficulty in the Electrical section has been the absence of "juice" for making preliminary tests and adjustments of various exhibits on site. Alternating current is there in plenty, and has been available for some time past on some stands, but D.C. supply has been sadly missed in the preliminary stages, and some of the exhibitors have been driven to the expedient of bringing batteries, ready charged, to the Exhibition, and taking them out again for recharging when necessary. Although there is a fine power station on site, time and circumstances have apparently conspired against those responsible for the distribution, but we live in hope that all will come right in time for the opening.

The industrious army of workers of all grades did not appreciably diminish with the advent of the Easter holidays, and Good Friday found us all hard at it as usual. The only people who under-estimated the holiday attendance were the caterers, who evidently thought the lure of a fine Easter would materially reduce the ranks to be fed inside the Exhibition grounds. Some of the cafés were closed on that day, and the resultant strain thrown on those which remained open created a famine in essential foodstuffs very early in the day. Along with others I managed to subsist on a dry ginger ale until late afternoon, when a species of "high tea" in the grill room saved the situation and enabled us to carry on. No doubt the feeding of the Empire visitors from the official opening onwards will be amply provided for; at all events, there is a generous choice of restaurants with tariffs to suit all pockets.

Another little difficulty we early business visitors have had to contend with has been the question of access to the grounds. Due to the long delay in issuing official passes, we have on occasions had to undergo a cross-examination into our credentials, and been called upon to produce documentary evidence of the fact that we were ready and willing to get on with the job inside, and that we were not merely idle sightseers obstructing the good work. However, these are but minor troubles, and, on the whole, the organisation of the preparatory work has been excellent, having regard to the magnitude of the conception.

It is early yet to discuss ways and means of seeing the Exhibition thoroughly, but my advice to readers at the moment is to concentrate on the Electrical section, which has been organised by the B.E.A.M.A. in one portion of the Palace of Engineering, and to aim at inspecting all exhibits in that section thoroughly before going any further. The nearest point of access is by way of Wembley Park Station on the Metropolitan Railway, from which you enter the Palace of Engineering at that end which is devoted to electrical exhibits, and you can rest assured that they make a brave show, and are well worth careful and prolonged inspection. All the best-known firms are staging representative exhibits, and the visitor is not left in any doubt as to the ubiquity of electricity in the service of mankind.

There is a feature of this great Empire display which is going to play its part in cementing the friendships already existing between Britons from all corners of the Empire. I refer to its function as a general meeting place, not in the conference or convention sense, but as a means of bringing together quite casually and unexpectedly friends and acquaintances from overseas who have seen nothing of one another for years. Already in the preliminary stages I have renewed acquaintance with many old friends of the electrical persuasion whom I had lost sight of years ago and never expected to see again. The B.E.E. is bringing them all to Wembley, like moths to a candle, and one catches a glimpse of familiar features mellowed, perhaps, by time; then, a second glance, sudden recognition, a mutual greeting and a chat over past experiences. There will be many such reunions between now and October next.

I heard a preliminary trial of the new loudspeaker installation which is being used in the grounds for broadcasting the King's speech at the opening ceremony. The apparatus marks a distinct advance on previous accomplishment, the reproduction from the level of the Never-stop Railway viaduct being exceptionally clear and audible from many yards distance, in spite of the hum of machinery and the buzz and rattle of lorries in the vicinity. I must congratulate Captain Eckersley and the B.B.C. on the fruits of their endeavours. I believe they have had an anxious time preparing for the event, and that matters were not in any way facilitated by the temporary disconnection of certain essential underground circuits to the Stadium due to the over-zealous efforts of a workman with a spade. The P.O. lineman who finally joined up my telephone told me that an 800-pair cable had been practically cut in two before the man realised that he was not exactly grubbing out old roots.

Those firms who specialise in electric vacuum cleaners should do good business among the exhibitors, for the Exhibition buildings will necessarily be very dusty places for some considerable time to come, and the cleaning of all kinds of valuable and complex goods becomes a problem of some magnitude. Concrete flooring, coupled with heavy traffic, conduce to a film of dust over everything exposed to view, and a thorough cleaning of stands and exhibits every day the Exhibition remains open, will be a *sine qua non.* The vacuum process of dust removal offers the best solution, and sponsors of electric vacuum cleaners should make the most of their opportunities.

Benevolence.

In the interests engendered by the Wembley Exhibition, and the noticeable improvement in the industrial situation throughout the country, we must not overlook the claims of charity. One of the most worthy causes of the many which to-day find it necessary to appeal for funds is that devoted to the interests of these deserving cases in the electrical profession which, through no fault of their own, have come upon misfortune. The Benevolent Fund of the Institution of Electrical Engineers should have the first call upon the pockets of those members of the Institution who are successfully earning a comfortable living in that industry, and who may, by a turn of Fortune's wheel, find themselves in a similar predicament at some future date to their less fortunate brethren whom the fund is intended to assist. I am advised by the Hon. Secretary that at present the expenditure practically equals the income, and that there is no margin for eventualities or to enable the scope of the good work to be extended. I cannot too strongly urge my readers to lend their aid, however small the amount, by subscribing to this thoroughly deserving and representative electrical Benevolent Institution. Donations should be addressed to the Hon. Sec., Benevolent Fund, Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2.

The National Register.

I have much pleasure in directing the attention of my many contractor readers to the letter in another column, in which Mr. Wordingham, the Chairman of the National Register of Electrical Installation Contractors, appeals for early application if they desire their names to appear in the first list of names actually passed and entered, because the necessary investigations take some time before that can be done, and the committee wish to avoid delay as much as possible. So hurry along, please.

"No Such Individual."

At the Front during the War I once spent a long time searching for an authority known as the Area Commandant. Before arriving in the region I had never heard of any such individual. I'm not sure whether that's an admission of my own dark ignorance or of the multitude of Army "big guns." Be that as it may, I and my valuable cargo of electrical gear spent many fruitless hours bumping over atrocious shell-pitted roads in search of the elusive Area Commandant. At one place I was assured that the officer was but a short distance away—a mere kilometre or so. A kilometre or so further on brought the information that there was "no such individual." Hours later I reached a desolate Nissen hut where a lonely clerk vouchsafed the news that the Area Commandant *had* had his quarters there until that very morning, but had moved to Chateau So-and-So. This was one of the places I had been through! So I decided to carry-on without reporting myself to the Will o' the Wisp of officialdom.

Now a little while ago it was stated in an American paper that the streets of Detroit, U.S.A., were still lighted by arc lamps—a method which, in spite of the useful flame arc, has been badly hit by the advent of the modern metallic-filament lamp. This was, therefore, rather diverting news, so ELECTRICITY office forthwith sent off a complimentary copy of Eck's "Application of Arc Lamps to Practical Purposes," published by this office when the arc lamp was in the hale and youthful stage. "Cast thy bread upon the waters," you know! Well, off went the book on a journey *I* wouldn't mind by way of a holiday, and addressed to the Engineer of the Detroit Electric Lighting Station. Time went by and lo! the wanderer returned to Maiden Lane none the worse for the long trip. It was the story of the Army officer over again. According to the notes on the wrapper, there was "no such individual." Of course, there *may* be a Lighting Engineer in Detroit and the "juice" *must* come from somewhere, but you know how modest and retiring they are on the other side of the herring-pond.

Somebody suggests that the arc lamps are fed from a primary battery (help!), but I'm inclined to think that a chap I once knew has been over there. The chap I mean reckoned that you could seal up an arc lamp for an interchange of carbon and the emission of light to go on for ever; he was going to get a patent for this illuminating idea and then set to work on the details. Patent *first*, mind you—*then* the details! I haven't seen the inventive chap since. Detroit is Mr. Henry Ford's home town, so perhaps the other enterprising benefactor of humanity received a ready welcome. (Perhaps!)

ELEKTRON.

WESTINGHOUSE DUAL FREQUENCY SUPER-CALENDER DRIVE.

By O. C. Cordes
(Paper Mill Section, General Engineering Dept., Westinghouse Electric and Manufacturing Co.)

(Concluded from page 206.)

The commutator type of frequency changer is much to be preferred to the induction type for obtaining a low frequency, as it is a much smaller machine and has much higher efficiency and better voltage regulation. An induction type frequency changer would be about twenty times as large as the commutator type, and would have losses some five or ten times greater.

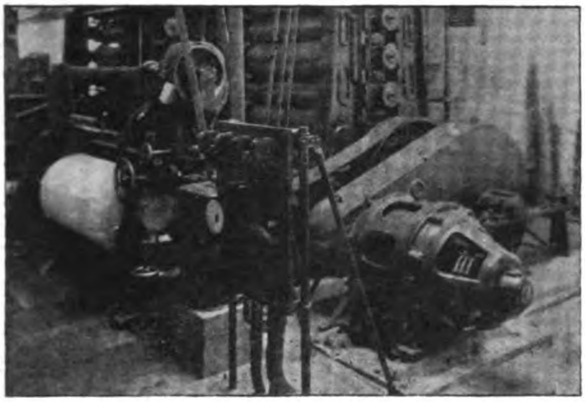


Fig. 4.—Side View of Calender Stack Showing Motor, Chain Drive, Control Panel and Type "S" Controller.

The schematic wiring diagram and layout shows a typical installation of the Westinghouse dual-frequency super-calender drive, together with the wire arrangement between the frequency changer, the motors and the control. It will be noted that the control and wiring is extremely simple, and that each super-calender operates entirely independent of the other. The capacity of the frequency changer is such that all of the super-calenders can operate at the "threading-in" speed at the same time. It will be noted from this diagram that a small motor generator set of less than 10 kw. capacity is shown supplying direct current to the motor driving the frequency changer. In a mill having direct current available this set is not required, nor would it be in cases where an A.C. driving motor is used.

The first of these installations was recently made in the plant of the Kalamazoo Paper Co., at Kalamazoo, Mich., where there are now nine super-calenders operating with this system, totally enclosed chain drives being used for speed reduction between motor and calender. These calenders were originally steam engine driven from a long line shaft to which they were belted.

Some of the advantages derived from this system of drive are:—

(*a*) Greatly increased production and flexibility
(*b*) Eliminaton of noise.
(*c*) Decreased lighting cost.
(*d*) Reduced physical exertion on operators.
(*e*) Increased cleanliness.
(*f*) Saving in oil and floor space.
(*g*) Reduced personal hazard and fire risk.

The satisfactory performance and marked economies in the operation of this installation is gratifying and much appreciated by the management.

The increase in production was effected by three major means, i.e.:—

(*a*) Increased speed of calenders.
(*b*) Greater flexibility of operation.
(*c*) Reduced physical wear and tear on the operator.

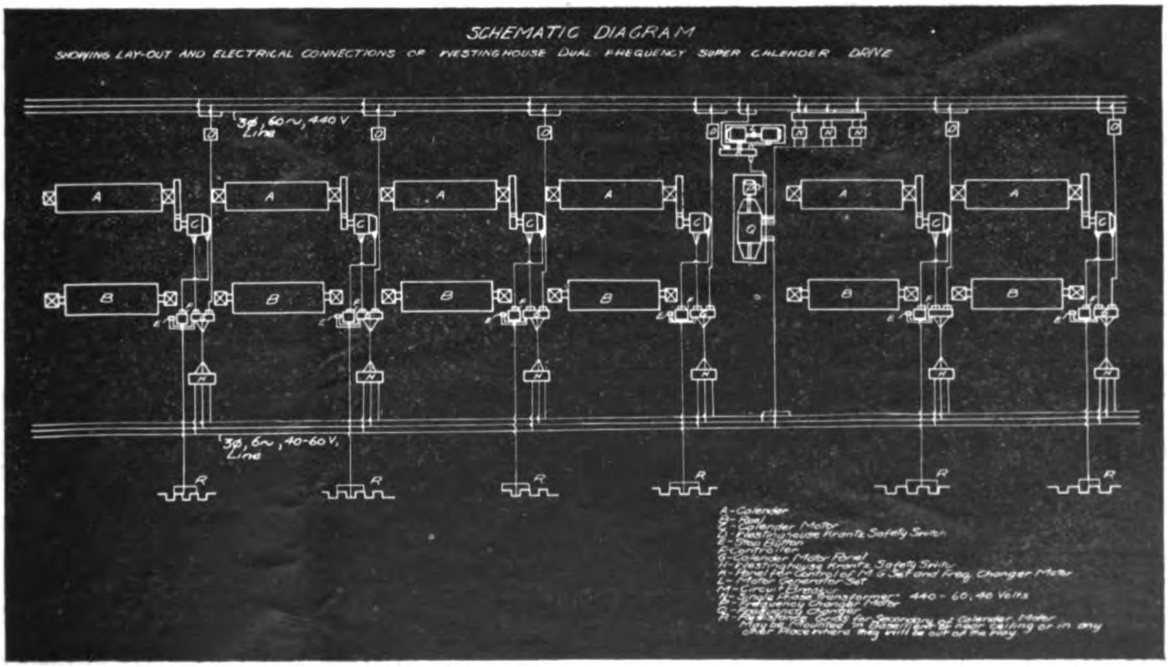

SCHEMATIC DIAGRAM
SHOWING LAY-OUT AND ELECTRICAL CONNECTIONS OF WESTINGHOUSE DUAL FREQUENCY SUPER CALENDER DRIVE
3φ, 60~, 440 V Line
3φ, 6~, 40-60 V. Line
A
B
C
D
E
N
Q
R
A-Calender
B-Reel
C-Calender Motor
D-Westinghouse Krantz Safety Switch
E-Stop Button
F-Controller
G-Calender Motor Panel
H-Westinghouse Krantz Safety Switch
K-Panel for Control of M G Set and Freq. Changer Motor
L-Motor Generator Set
M-Circuit Breaker
N-Single Phase Transformer 440 - 60; 40 Volts
P-Frequency Changer Motor
Q-Frequency Changer
R-Resistance Grids for Secondary of Calender Motor May be Mounted in Basement or near ceiling or in any other place where they will be out of the way.

Fig. 5.—Schematic Diagram.

The old belt drive, together with the gearing and clutch mechanism on the calenders, was exceedingly noisy, very dirty, greasy, and a pronounced fire hazard. Furthermore, the numerous belts required cut off a considerable portion of daylight from the room, and made it necessary to resort to artificial illumination. The continual shifting of clutches required by the old method of drive tired the operators physically, so that during the latter part of the day production fell down very materially. This condition was noted particularly in the specific case where two light-weight men were operating a calender stack. There the production was increased some 20 per cent., due entirely to the more flexible and easy operation of the dual-frequency system of drive.

According to the figures obtained from the management of the Kalamazoo Paper Co., the production has been increased 25 per cent. by the installation of this new type of super-calender drive.

The space requirement for this type of drive is very much less than that required by the old method, and, besides, it has the further advantage in that the control can be located where it is deemed most convenient for operation. Therefore, the only piece of apparatus which is truly fixed is the motor and the drive. In the old type of drive all parts are fixed permanently, so that they cannot be shifted to suit the space into which they are to fit.

Through the able handling of the installation work by Mr. W. H. Scott, chief engineer for the Kalamazoo Paper Co., and his assistants, the change over from the old belt drive to the new Westinghouse dual-frequency drive was effected without loss in production.

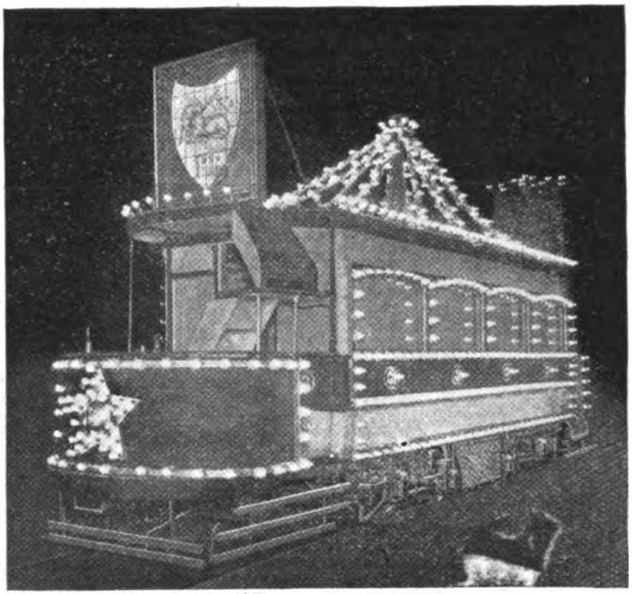
THE VALUE OF GOOD LIGHTING IN STREET AND FACTORY.

A few months ago Mr. Leon Gaster delivered a broadcast talk on illumination, and on April 14 a second talk was given, this time dealing with the lighting of streets and factories. The main point emphasised was the value of good lighting in preventing accidents. Mr. Gaster pointed out how the growth in motor traffic has revolutionised lighting conditions in our streets. He looked forward to the day when maintenance of public lighting would, like the upkeep of the road-surface, be regarded as a national obligation. In the factory good illumination has an equally good claim on humanitarian grounds, and in mines it would probably have a most beneficial effect in reducing nystagmus—a disease that incapacitates about 6,000 men every year and costs the country about £1,000,000 in compensation. These are points that deserve to be brought before the public notice, and the B.B.C. has done good service in providing an opportunity of making them widely known.

Meetings.—At the meeting of the Inst.C.E , to be held on the 29th inst., the papers on "The Barton Power Station of the Manchester Corporation, and the Transmission System in Connection Therewith," by H. N. Allott and S. L. Pearce, C.B.E., M.Inst.C.E., and the "Dalmarnock Electricity Works," by W. Burnside, Assoc.M.Inst.C.E., will be further discussed.——A wireless section meeting of the I.E.E. will be held on Wednesday, May 7th, at six p.m. Paper: "Faithful Reproduction in Radio Telephony," by L. C. Pocock, A.M.I.E.E.

PRESTON ILLUMINATED TRAMCAR.

With the new power station nearing completion there is evidence of a "certain liveliness" in the Preston Corporation Supply area. Following on a very successful Electrical Exhibition—which attracted an attendance during the five days of nearly 20,000 visitors, and accounted for the installation (either sold or on hire) of 75 electric cookers, in addition to which the local contractors reaped a reward in the sale of supplies, fittings and domestic appliances—the Preston Shopping Festival Committee arranged for a shopping week to be held from March 28 to April 5. In this electricity has been kept well to the forefront, and the Preston Tramways Department lent a hand by designing a most attractive illuminated tramcar (illustration herewith). Apart from the fact that they adhered to the colour scheme decided on—amber and black—there was no suggestion of advertising on the car. There was, however, a novel suggestion conveyed to the public by a large illuminated facsimile of the Corporation coat of arms, which was mounted on the front of the car and a decorative "magicoal" electric fire mounted on the back. Both these signs, one implying on the part of the Corporation a willingness to serve and co-operate in any scheme which may benefit the town, the other showing how electricity can serve both for lighting and heating, were beautifully illuminated, and they introduced an element of novelty to the design.



The various circuits were controlled by a motor-driven "crawling flasher" carried inside the car, so that a variety of "effects" were being constantly produced. Siemens lamps, both metal and carbon filament, were employed throughout for the lighting scheme, about 300 white and 500 coloured a rich amber.

The tramways manager, Mr. H. Clayton, and the staff are to be congratulated on the result obtained, and both residents and shopkeepers seemed to appreciate the assistance thus given to their shopping week venture by the Tramways Committee.

ELECTRIC DRIVING OF A MODERN FACTORY.*

By F. W. Smith, N.A.S.E.

(*Continued from page* 198.)

Spur driving is quite satisfactory, and is an excellent method of driving. It, however, requires careful designing to give efficient running, as not only must the gears be properly meshed when standing, but the motor and machine must be bolted together, as there is a tendency for the machine to creep away from the motor, with disastrous results to the pinion. The motor is usually mounted on a specially-designed bracket bolted direct to the end frame of the press, and great care must be exercised in the design of the bracket in order to relieve the end frame of undue stresses.

Chain driving also has its advantages, it permits the motor to be placed close up against the machine, and can be used with excellent results on the old type of Miehle machine.

Motors—these should be of the semi-enclosed type with totally enclosed upper housings, to guard against ink, paper and the like falling on the commutator. They should be compound wound, or have series steadying turns as some prefer to call it. The compound motor has a speed characteristic that is intermediate between those of shunt and series motors, at no load the flux is practically all due to the shunt winding, the effect of the series winding being almost negligible because we then have full field, maximum speed and back E.M.F., and minimum armature and series current. The series is arranged to assist the shunt winding, and the two fields produce flux in the same direction round the magnetic circuit. When a compound motor is being loaded up, the flux increases and the speed decreases. The difference in the speed between no-load and full-load depends upon the proportion of the series and shunt ampere-turns. It has been found by test that compound wound motors working on flat-bed machines actually reduce the current consumption by as much as 5 per cent. of the total units used per day, due to the strengthening of the field at the moment of reversal and the magnetic induction at this moment. The speed range of printing machine motors are usually about 2 to 1, but in some cases it is necessary to go up to 3 to 1. To accomplish this they are usually fitted with interpoles, and there must be no sparking of the brushes through the entire range of speed. The brush gear is perhaps one of the weakest points in electric motors, and is a continual source of trouble in the cheaper type of motor. The box type of brush gear is perhaps the best—avoid finger type as you would a plague. It is false economy to instal a second-rate motor on a valuable printing machine. The greatest enemy of the printer is a breakdown. This can be reduced to a minimum if the right motors and controllers are installed, after all, the cost of the electrical equipment is small compared with the cost of a modern printing machine.

MOTOR CONTROL.

There are three methods of control in general use on printing machines of the flat-bed type, namely, hand operated, semi-automatic, full automatic.

The Hand Operated face plate type should never be used on a printing machine job unless it is fitted with a clapper switch and carbon breaks, as the continuous starting and stopping of the press will very soon burn away the first two contacts on the starter. On a really good-class job these starters are never used. They are, of course, quite suitable for line shaft drive, or where one is starting on a loose pully, but as we are not dealing with shaft driving there is no need for me to go further into these details. *Under hand-operated comes the drum controller.* This type of controller is very useful where the initial cost is the first consideration, and when properly designed is very reliable. It must not under any circumstances be just an ordinary drum controller. It must be designed on the multiple break system, having long inching bars which enable the operator to inch without having to take his attention from the work. It should be provided with renewable finger tips, carbon breaks, and magnetic blow-outs, and must stand an unlimited amount of really rough handling. The resistances can be self-contained in the controller proper on the small sizes up to say 5 h.p., above this it is advisable to have the armature resistance in a separate unit, which can be fitted under the footboard or any other convenient place. The shunt regulating resistance can be retained in the drum case. It is at times more convenient to provide a separate shunt regulator, but in either case it must be electrically interlocked with the controller to ensure starting the motor on full field.

Semi-Automatic.—In this type of starter we have a clapper switch for inching and stopping, which is operated by push-button control. The speed of the motor is controlled by armature and shunt resistance. The only advantage this type of starter has over the drum type is that one is able to inch by pressing a push button. It is doubtful if this is really an advantage, as one has still to bring the starter handle up to the desired contact, which really means two operations against that of one on the drum controller.

Full Automatic.—None of the methods I have mentioned can be compared to the full automatic. In this type of control the human element is entirely eliminated, beyond the mere fact of pressing a button. It takes the speed of starting up and the ultimate running speeds entirely out of the hands of the operator. It can be placed in any convenient position on the wall, floor, or even mounted under the delivery board of the machine itself. It should be totally enclosed in iron housing, making one compact unit. The starter proper consists of an automatic self-starting rheostat, combined and interlocked with a single-pole magnetically operated circuit breaker and shunt regulator, with a double-pole switch to isolate the complete machine.

All making and breaking of the current during inching is carried out by the automatic circuit breaker, which is provided with heavy contacts and magnetic blow-out, and unlimited inching can be carried out without fear of breakdown. The machine is always brought up to speed with smooth and steady acceleration, eliminating shock to the motor and machine. The starter is operated by a small "master switch" fixed on the printing machine in a position near to the layer-on. This is the only switch he has to handle, and it is less trouble to operate than the ordinary brake lever. The printing machine speed is directly under the control of the machine room manager, he alone sets the speeds, and is therefore able to estimate accurately the number of copies the machine will give, and can arrange his work accordingly. There is no system of control which appeals more to the machine overseer than that of the full automatic, and it has become the universal type amongst the leading printers of to-day.

---

* Lecture delivered before the N.A.S.E.

(To be continued.)

Correspondence.

THE NATIONAL REGISTER OF ELECTRICAL INSTALLATION CONTRACTORS.

To the Editor of ELECTRICITY.

Sir,—A few weeks ago you were good enough to comment favourably in your journal on the inauguration of the National Register of Electrical Installation Contractors, for which I now take the opportunity of thanking you cordially. It will no doubt interest you to know that certificates of registration are now being issued to installation contractors who comply with the requirements of that body, and that applications for registration are being dealt with as rapidly as the necessary investigations make possible.

The National Register propose to publish in your advertisement columns at an early date a first list of registered contractors under the headings of the respective towns or localities in which they carry on their businesses. The need of such a register is unquestioned, judging by the manner in which its establishment has been received, and by the absence of any unfavourable comment or criticism, and is evidenced by the stream of applications for registration which is steadily flowing in, and the inquiries which accompany these applications as to publication of the names of those applicants entered on the register and to whom certificates are granted. May I ask you to bring to the notice of wiring contractors who have not yet sent in their applications, through your widely read columns, the advantage of doing so at the earliest moment if they desire their names to appear in the first list of registered installation contractors entered on the register to be published, and to remind them that every application takes a certain amount of time for investigation before names can be passed by the Executive.

The fee payable on application covers registration until April 30, 1925, when the registered contractors' certificates become renewable. Applications should be addressed to the Secretary, 1, Lincoln's Inn Fields, London, W.C.2, who will supply application forms and answer any queries.

Inquiries as to the publication of lists of registered installation contractors are not confined to applicants for certificates and those to whom they have been granted, but are coming in from quarters in which lie the giving out of wiring work, and the wish to comply with such an evidenced desire is the main reason for my asking for your kind offices and the indulgence of your columns in reaching the interested parties concerned.—Yours faithfully,

C. H. WORDINGHAM, Chairman.

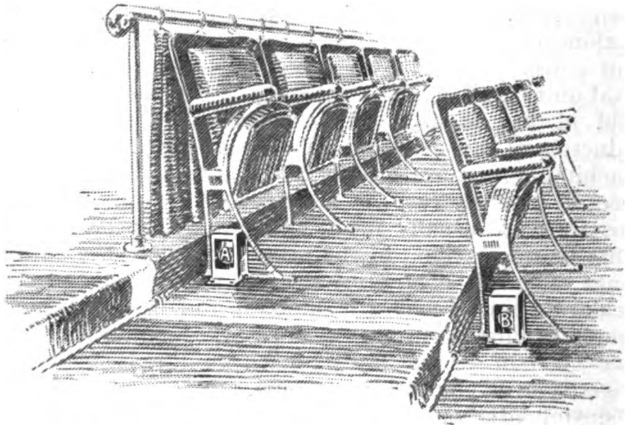
Old age may creep on you, but don't let it jump on you.

THE CRYSTAL PALACE SCHOOL OF ENGINEERING.

Professor Henry Adams, M.Inst.C.E., addressing the students of the Crystal Palace School of Engineering recently in a bright, cheery speech, told one or two amusing stories. He was once asked to take a couple of schoolboys to the Zoo whilst their father, a dock engineer, was giving evidence on a Parliamentary Committee. The next time he saw the elder boy, after giving him elephant rides at the Zoo, the lad was President of the Institute of Civil Engineers. The best definition, said the Professor, of serving was the capacity for hard work, and he said it was the busy man who could always find time to do a little extra. If they wanted a thing done never go to a man who had plenty of time on his hands. In addition to his daily work as an engineer he had given 10,000 evening lectures, so that they would realise that he practised what he preached. There was much to be thankful for in an engineer's life; it was full of variety, and if he took an interest in it, he wanted no other amusement.

CINEMA LIGHTING.

The question of subdued yet adequate lighting of cinemas during the actual projection of the picture has always been of direct interest to cinema proprietors, and it has therefore appealed to the enterprise of the illuminating engineering department of the G.E. Company, who are suggesting a plan which should offer a fairly satisfactory solution. It is the use of small "Osglim" Neon lamps, having a current consumption of approximately 5 watts, with about ¼ to ½ c.p. These give a light of a pleasing orange tint, without any appreciable glare, and for step lighting can be installed in small wire cages under the outside seat of each row, as shown in the annexed illustration.



Not only does such an arrangement enable the gangway to be located when the main lighting is extinguished, but as the lamps are supplied in the form of letters and figures, the lighting can be made to serve a double purpose in distinguishing the various rows of seats. Further, as each lamp consumes only 5 watts, it would appear that an important saving could be effected in current consumption if a secondary circuit were installed and these lamps incorporated in the ordinary fittings, to be switched on when the normal lighting is extinguished.

A model showing the complete scheme can be seen at the showrooms of the General Electric Co., Ltd., at Magnet House, Kingsway, and should most certainly be inspected by all picture palace proprietors as well as by architects and installation contractors. They will find the illuminating experts ever ready to render every assistance in their power.

WATER-TUBE BOILERS.

During the discussion on April 11 of Mr. L. M. Jockel's paper, "Water-Tube Boilers," read before the Junior Inst. of Engineers last month, many arguments for and against powdered fuel were heard. Mr. Jockel had suggested that the boiler of the future would use powdered fuel, and would have the furnace refractories cooled by the feed water. Mr. Charles Erith pointed out that water-cooling in the furnace was a very difficult proposition, and in cases where the whole of the furnace walls were water-screened a very considerable proportion of the steam was generated in these accessory boiler-heating surfaces, which constituted a sort of huge "bird-cage" extension of the boiler proper. Powdered fuel only increased these difficulties. He said that he thought the boiler of the future would be of the simplest character, stoker-fired, and without water screens, furnace arch, or flue gas air heater, the air for combustion being heated by using hollow furnace walls. Mr. Erith quoted an American test on a stoker-fired boiler with economiser, but no preheater, showing an efficiency of 92.7 per cent. Mr. Jockel said, however, that he was not prepared to believe any efficiency over 90 per cent.

Mr. F. F. Evans put forward some of the advantages which powdered fuel gave, in spite of its cost. He said that this was the era of bigger turbines, and consequently bigger boilers, and one immediate effect of powdered fuel firing was that it increased the capacity of a boiler. For a boiler being converted to burn powdered fuel, a guarantee was given to increase the evaporative capacity from 35,000 lb. per hour to 77,000 lb. per hour. Powdered fuel showed better efficiency than stoker-fired boilers under the varying conditions of station working. With stokers it was difficult to obtain complete combustion of the fuel, or to keep the temperature of the air constant, or, when these things had been done, there was great difficulty with accumulations of ash. With powdered fuel, all heat losses during the banking period were abolished, and improvements in furnace design were overcoming difficulties of refractories.

Mr. F. D. Napier mentioned the subject of circulation, which, he said, had not always received sufficient consideration. As far as steam-raising ability and ultimate capacity were concerned, the important factor was circulation. The precise action of the water in a boiler could never actually be ascertained, but some designs seemed to ensure sufficient circulation more than others, and were consequently less liable to produce tube failures. He agreed with Mr. Jockel that boiler efficiency depended more on working conditions than on the make of the boiler. A set of Lancashire boilers was showing an overall yearly efficiency of 74 per cent.

The discussion also centred around the question of air preheaters, and Mr. R. H. Allen and Mr. Lindhirst gave particulars of the Thermix and Ljungstrom air preheaters respectively. Mr. Allen said that boiler temperatures were not increased by using preheated air so much as was imagined, and, if the temperature of the air for combustion was raised by 400 deg. Fahr., the furnace temperature would be increased only by 300 deg. It was said that trouble from deposit on the heating elements occurred only rarely, generally when using bad coal, and any deposit, which was usually only fine ash, could easily be removed by a jet of steam or by increasing the flue gas velocity. The amount of energy absorbed by air preheaters was very small, not more than 0.5 per cent. of the total boiler output. Mr. Jockel gave details of a new test on a Ljungstrom preheater, showing a saving of fuel to the extent of 13.6 per cent., after taking into account the energy absorbed by the fans.

Mr. R. H. Parsons, who was in the chair, mentioned the excellent efficiency which was being obtained at the Barton power station, and said that such efficiencies would probably become more common in this country with the advent of bigger stations.

Reviews of Books, &c.

[Books noticed in this column will be sent from ELECTRICITY ***Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]***

ELECTRICAL ENGINEERING TESTING. By G. D. Aspinall Parr. Fourth edition. 691 pp., 296 figs. (Chapman and Hall, 16s. net.)—Little need be said by way of bringing to the notice of our readers the fourth edition of what has long been regarded—and rightly so—as one of the best available works on electrical engineering testing. Excellent as it was in its earlier editions, the book has now been very materially improved by the addition of some 132 pages of new matter, no less than 116 of which represent entirely new tests, including such additional theoretical explanatory matter as it has seemed desirable to add concerning the previously existing tests. Some of the tests now included for the first time relate to direct current problems, but the remainder, forming by far the greater proportion of the new tests, relate to alternating current. This branch of practical work, always more difficult to understand than that of direct current, has therefore been greatly strengthened by new matter relating to modern theory and laboratory and commercial tests. A number of new and valuable vector diagrams have been included in these sections. The general rearrangement of the work as a whole has brought all tests of a like nature together, and this, in our opinion, constitutes a further improvement. Needless to say, the book is admirably indexed, so that it meets the requirements of the practical worker as well as those of the student following a regular course. All of the tests likely to be required in continuous and alternating current practice are dealt with individually. The method of treatment is in each case the same, viz., an introductory note is first given, explaining all the factors bearing upon the test. The apparatus and observations required are then enumerated and discussed where necessary. Suitable forms for recording results are suggested, and such general notes as are required to enable the test to be made intelligently, and with profit and accuracy, are appended.

Various Items.

Removal.—The Leeds office of the Consolidated Pneumatic Tool Co., Ltd., has been moved to 67, St. Paul's Street, Leeds.

Situation Vacant.—A handy man is wanted by W. Chapman, Heppington, Canterbury. Must be thoroughly experienced with private electric light plant, oil engine, and make himself generally useful; cottage found; state wages.

Italy.—A report has been published on the position of wireless telephony and telegraphy in Italy, and copies of it may be obtained by U.K. firms interested, upon application to the D.O.T., at 35, Old Queen Street, London, S.W.1.

Germany.—The report of the D.O.T. on German trade during March shows that so far as the electrical industry is concerned business has continued fairly active and in some parts become more lively. German tramways and light railways are placing more orders, and other orders have been given for telegraph and telephonic material for the Imperial posts and railways.

Crystal Palace Old Students.—The Crystal Palace Engineering School Magazine for the Easter term has just made its welcome appearance. It contains an interesting report of the proceedings of the Old Students' Society, as well as of papers which have been read and the address which was given by Mr. A. Stewart Buckle, the new president. It is a pleasure to note that the old students are still doing well in all parts of the world.

The Machine Tool Exhibition.—We have received from the Machine Tool Trades Association, of 70, Victoria Street, S.W.1, a preliminary list of the exhibitors at the third Machine Tool and Engineering Exhibition which is to be held at Olympia from September 5 to 27 next. As it is four years since the last similar exhibition was held it should reveal to the engineering public the very great advances which have been taking place in the last four years.

Switzerland.—The report on the Economic and Commercial Conditions in Switzerland has just been issued by the D.O.T. and may be obtained from H.M. Stationery Office or Electricity office, price 2s. 9d. post free. It is a book of 88 pages, and contains much matter of interest to commercial men. So far as concerns the electrical trade this appears to have been having a very quiet time. The U.K. purchased dynamo electric machinery to the extent of 318 tons during the twelve months and one electric locomotive.

Liverpool.—On Monday, 14th inst., at the University of Liverpool, the ninth ordinary meeting of the I.E.E., Mersey and North Wales centre, took place, when an informal discussion on domestic electrical appliances, illustrated by lantern slides, was opened by Mr. J. W. Beauchamp, there being an attendance of about 250 and many ladies. During the evening an extensive exhibition of lighting, heating, cooking and wireless apparatus in action was arranged in the University by the Electricity Supply Department, the local contractors, and the University helpers, electrically cooked refreshments being served.

Scholarships.—As a result of the examination held at Faraday House on the 8th, 9th and 10th inst., the following awards have been made, namely: W. J. L. Wildbore, the "Faraday" Scholarship of fifty guineas for two years in college and one year in works; D. Parkinson, the "Maxwell" of fifty guineas for one year in college and one year in works; F. A. Peachey, an Exhibition of forty guineas for one year in college and one year in works; J. G. Bentley, an Exhibition of thirty guineas for one year in college and one year in works; C. F. Ellis, an Exhibition of thirty guineas for one year in college and one year in works; and W. A. R. Smith, Norwich, an entrance prize of twenty guineas.

Tenders Accepted.—The Admiralty have accepted the tender of Siemens and English Electric Lamp Co., Ltd., for the supply of a large number of Siemens lamps for various dock-for train lighting. The Salford Tramway Dept. have accepted by the London Electric Railway for Siemens traction type lamps for train lighting. The Salford Tramway Dept. have accepted the tender of the G.E. Co. for a supply of Osram traction lamps, and the Port of London have placed a three months' contract with the G.E. Co. for the supply of Osram gasfilled lamps, commencing with April 1. The Admiralty have also accepted the tender of the Ediswan Co. for the supply of metal filament lamps. The Belfast Electricity Committee have accepted the tender of the Siemens and English Electric Lamp Co., Ltd., for the supply of lamps for twelve months commencing 1st inst.

Netherlands.—A report on trade conditions in the Netherlands to February, 1924, has been issued by the D.O.T., and may be obtained from H.M. Stationery Office or Electricity Office, price 2s. 2d. net post free. Apparently many of the industries in Holland are having a quiet time, but the incandescent lamp trade is still very busy, more particularly in regard to export.

Legal.—In the case of the Marconi Wireless Telegraph Co. *versus* the Mullard Radio Valve Co., Ltd., the House of Lords have upheld the claim of the latter that the Mullard valves do not infringe the patents of the Marconi Co., and the case was therefore dismissed with costs. The Mullard own and operate nearly 100 valve patents, and every one of these implies a definite advance in construction.

Meetings.—The Junior Inst. of Engineers will meet on Friday, May 2, at 39, Victoria Street, at 7.30 p.m. Lecturette, "Electric Lighting in Churches," by F. H. Taylor, A.M.I.E.E. (Member).——The Illuminating Engineering Society will meet at the Society of Arts at 8 p.m. on Monday, 28th inst., when a discussion on "Some Problems in the Lighting of Textile Mills" will be opened by Mr. E. L. Oughton (gas lighting) and Mr. P. J. Waldram (daylight illumination).

The "P.O.E.E. Journal."—The April issue of this journal contains several papers of interest to the readers of Electricity, including Part 4 of "The Romance and History of the Electric Telegraph," by Mr. A. H. Roberts, and a clear explanation of the Post Office exhibit which will be made at the British Empire Exhibition. There are papers dealing with the calculations of lamp-burning hours, the number of switches in an automatic telephone exchange, and details and tests of water-cooled valves at Northolt Radio Station.

Personal.—Mr. L. J. Ellacott Genner, who for some years past has been responsible for Western Electric Advertising, is transferring his services to the Paint More Campaign of the National Federation of Paint, Colour, and Varnish Manufacturers of Great Britain. He leaves the electrical industry with the good wishes of a host of friends.——Mr. A. T. Davey has resigned his position as hon. sec. of the Inst. of Production Engineers, as he has taken up a position with Messrs. W. H. Allen and Sons, Ltd., of Bedford. The appointment will in future be filled by Mr. E. D. Ball, 20, Lushington Road, N.W.10, to whom all communications should be addressed. A suitable acknowledgment of Mr. Davey's invaluable services will be made in due course.

Trade Notes.

The Cambridge and Paul Instrument Co., Ltd., of 45, Grosvenor Place, London, S.W.1, have just issued a well illustrated 48 pp. catalogue and text-book on Cambridge A.C. Instruments for high-frequencies, which they will willingly send free to any reader on request. Technically it is worth writing for and then studying carefully.

An artistic and beautifully illustrated catalogue of electric light standards, fittings, pendants and brackets has been issued by **Messrs. Galsworthy, Ltd.**, 15/16, Newman Street, Oxford Street, London, W.1. Although wonderfully artistic, yet on the other hand the firm have confined this to patterns of moderate prices which they find are most suitable to the present-day market, and as they are wholesale manufacturers with showrooms, the catalogue should appeal directly to all trade dealers and contractors who can send their customers to the firm for selection purposes.

"The Origin of Period Decoration" is the title of an exceedingly interesting piece of publicity literature which has just been issued by the **Edison Swan Electric Co., Ltd.** It gives illustrations of decorations from the time of the ancient Egyptians, 1300 B.C., down through the Assyrian, Greek, Roman, Saxon, Gothic, Tudor, etc., periods, and will therefore appeal to all who are giving careful consideration to the question of using fittings which shall harmonise with the period decoration in the room in which they are placed.

Printing.—We have received from the **Printing Trades Alliance**, of 8, Farringdon Avenue, London, E.C.4, a copy of the list of open houses in the printing and allied trades in London districts observing standard rates and conditions. This Alliance, which is a registered trade unioin, aims at promoting sympathetic co-operation between employers and employees in order to avoid the troubles that have arisen in the past when disputes have occurred.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

MAY 2, 1924.

CONTENTS. PAGE

Development of the Bellini-Tosi System of Direction Finding in the British Mercantile Marine 225
Telephony (Solutions) 226
The B.T.-H. Stand at the Preston Exhibition 227
Protecting Cable Ends from Moisture 227
Questions and Answers by Practical Men 228
Current Topics 231
"Some Idiosyncracies of Electrical Manufacturers 233
New Relay Has Self-Contained Ammeter 233
Electric Driving of a Modern Factory 234
A Universal Meter for Electric Power 235
Radio Receiving Circuit Taking Power from Lighting Mains 235
Tensile Strength and Electrical Resistance of Copper .. 236
Reviews of Books 236
Various Items 238

DEVELOPMENT OF THE BELLINI-TOSI SYSTEM OF DIRECTION FINDING IN THE BRITISH MERCANTILE MARINE.*

By COM. J. A. SLEE, C.B.E., R.N. (Ret.), Member.

(*Continued from page* 212.)

By far the best construction for loops, working within the limits of wave-length mentioned in this paper, is to support them on five light spars, so that the dimensions of the loop are about 8 ft. high by 30 ft. to 40 ft. wide, the apex being about 6 ft. above the upper outer corners. Spars about 25 ft. long with 6-in. heel tapering to 4-in. heads will generally meet the case, or a bridge can take the place of one of the spars, or even of two of them. These spars must be placed with accuracy, the error of alignment of the sheeves not being allowed to exceed 1 in. Such an outfit can, as a rule, be made absolutely permanent, and is independent of changes of temperature and the working of the ship in a seaway. Figs. 1 to 3 show various methods of attaching aerials.

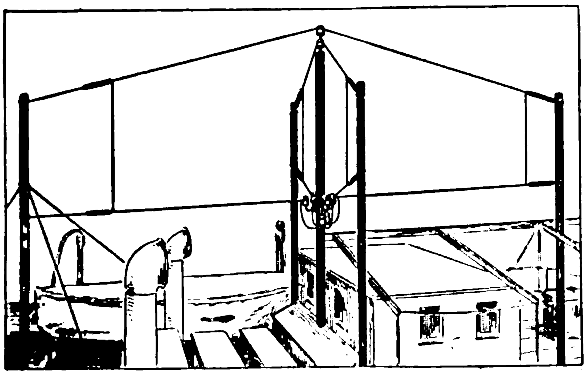


FIG. 1.—DIRECTION-FINDER AERIALS SUPPORTED ON POSTS; S.S. "MOTAGUA."

The insulation of the apex of the loops is not of very great importance, but at all other points at least a 10-in. surface should be provided.

Very considerable trouble has been experienced in the past due to injury to the lead-covered cable between the loops and the direction-finder instrument. These are now generally run in steel conduits. Armoured lead-covered cable has been tried, and is satisfactory if either the lead sheathing or the armouring can be earthed at intervals of not more than 20 ft.; but, on the whole, plain lead-covered wire in steel conduits is the most satisfactory.

The ends of the paper cable are protected by cast-iron bifurcating boxes of the usual commercial pattern. When close to a compass wooden boxes are used. One of the minor difficulties of installing a direction-finder set in a ship is the protection of the ends of the paper-insulated cable from damp during the work of fitting.

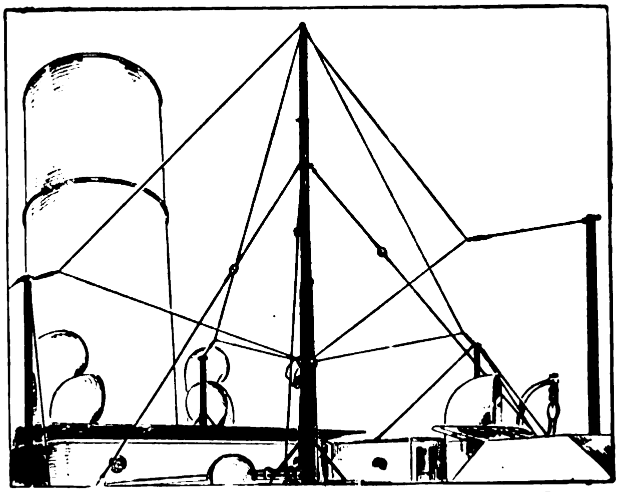


FIG. 2.—DIRECTION-FINDER AERIALS FITTED ON POSTS; S.S. "MOOLTAN."

After the loops are erected and have been proved to be geometrically correct and good for continuity and high insulation, they should be excited singly by a shunted buzzer as loops (not as plain aerials) and their wave-length checked. This should be below 400 m., preferably below 350.

The symmetry test should then be applied, and, if the loops prove correct, the work of calibration can be commenced. But it is absolutely useless to attempt to calibrate until loop-tuning and lack-of-symmetry errors have been stamped out.

(4) TESTING FOR SYMMETRY.

The principles on which a symmetry tester is arranged are as follows:—

Consider a single loop with its field coil. Let this be excited as a "plain" aerial—say, by means of a shunted buzzer connected to a straight lead between the mid-point of its field coil and earth. If the loop under test is symmetrical, current will be exactly divided between the two halves of the field coil, and, consequently, there will be zero resultant magnetic coupling between the field coil and the search coil. There will be a certain electrostatic coupling between the field and search coils, which will be greatest when the search-coil windings are nearest to the field coil under consideration. If the search coil is turned round, clear signals will be heard in the telephones, and the strength of signals should be adjusted by means of the coupling to the shunted buzzer until they are just comfortably audible at the maximum positions. If, now, one side of the loop be disconnected—giving the maximum lack of symmetry—signals will become very much louder, and will be audible nearly all round the scale. A very slight lack of symmetry will cause a magnetic coupling between the field and the search coils, which will have its maximum effect in the same position as the electrostatic coupling. As the magnetic coupling is dependent on the sense of the windings, and the electrostatic coupling is not, these two will be in conjunction in one position of the search coil and in opposition in the opposite position, a slight lack of symmetry being betrayed by the fact that the signals are not of equal strength when the pointer is at these two opposite positions on the scale.

---

* Paper read before the I.E.E.

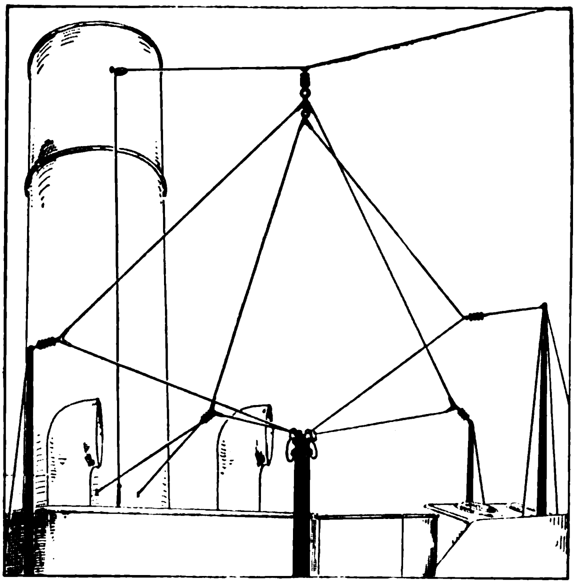


FIG. 3.—DIRECTION-FINDER AERIAL HUNG FROM JUMPER STAY.

When both loops are joined to their field coils and the whole system is excited through its common mid-point as above, it might be expected that signals would (under suitable conditions of buzzer coupling) be just audible when the search coil was exactly inside each field coil, so giving four positions of audibility at 0 deg., 90 deg., 180 deg. and 270 deg. (scale marked with 0 deg. right ahead), but this is not the case, as the two combined electrostatic couplings have their maximum intensity at 45 deg., 135 deg., 225 deg. and 315 deg. This is possibly a peculiarity of construction of the instruments with which all available experience has been gained.

Hence, the result of exciting a pair of properly symmetrical loops is to produce zones of clearly audible signals when the pointer is near to 45 deg., 135 deg., 225 deg., 315 deg., with well-marked silent zones around 0 deg., 90 deg., 180 deg. and 270 deg. If one of the loops is but very little out of symmetry the silent zone about one of these points is obscured, and signals at one pair of 45 deg. are louder than at the other, with the result that signals become audible over a wide band about 0 deg. and 180 deg. (or 90 deg. and 270 deg.) with ill-defined minima between.

(To be continued.)

TELEPHONY.*

Being solutions to questions selected from the Telephony, Grade I., Examination, held by the City and Guilds of London Institute on May 3, 1923.

(*Continued from page 211.*)

Q.—An aerial line one mile long is required, in a country district, to serve a group of four subscribers. Name the principal items and quantities required for its construction.

A.—The following stores would be required:—

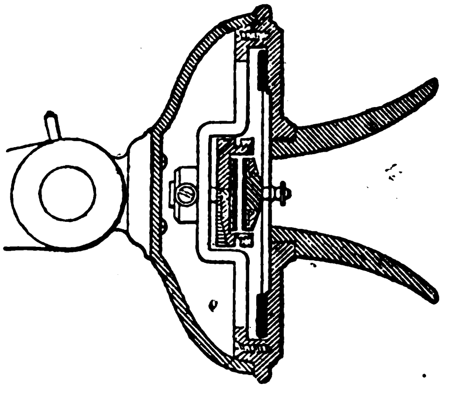
Poling Stores:—
- 27 30-foot light poles.
- 27 galvanised iron roofs
- 4 stay rods.
- 4 stay blocks.
- 1 cwt. $\frac{7}{8}$ galvanised iron stranded wire.
- 324 yards of 400-lb. galvanised iron wire for earth-wiring the poles (12 yards per pole).
- Small quantities of rose-headed nails for fixing roofs; staples for fixing stay and earth wires to poles; tar, tallow and pitch compound for stay rods.

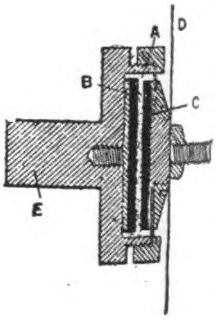
Arming Stores—
- 54 42-inch arms.
- 54 arm-bolts.
- 54 large washers for arm bolts.
- 54 small washers for ditto.
- Small quanity of tar and creosote for coating arm slots.

Wiring Stores—
- 216 double-shed insulators.
- 216 spindles.
- 216 india-rubber rings.
- 3 cwt. 40-lb. bronze wire.
- 216 bronze binders.
- 216 bronze tapes.
- Small quantity of hook guards, jointing wire, solder and soldering fluid.

Q.—Sketch and describe a transmitter suitable for use on a common battery telephone.

A.—The two figures show the construction of the "solid-back" transmitter which is extensively employed in common battery working. *D* is an aluminium diaphragm provided with a soft rubber band round its periphery. It is held in position, and its movements are damped by two rubber-tipped steel springs (not shown in the figure), one of which presses against the





---

* Books recommended are *Questions and Solutions in Telegraphy and Telephony, Grade I.*, by Few (Rentell, 5s. 10d. post free) and *Practical Telephone Handbook*, by Poole (Rentell, 15s. 6d. post free).

central portion of the diaphragm, and the other against the edge of the diaphragm. The carbon blocks *B C* are the electrodes. They are electroplated, and are enclosed in a chamber formed by the hollow metallic block *E* at the back and by a mica washer in the front. The chamber is insulated with a lining of paper. The back electrode is secured to the metallic block *E* by a small screw, and the front electrode is secured to the mica washer and the diaphragm *D* by another screw. This screw is provided with a small nut by means of which the pressure on the diaphragm may be varied within small limits.

For ordinary telephone working the chamber is filled three-fourths full of carbon granules, and for common battery working about one-half full—the smaller quantity of granules being used to increase the resistance of the instrument. The granules should be hard, polished, and of uniform size.

The front of the instrument is of cast brass, and the mouth-piece is of hard rubber.

The front electrode is connected by a flexible wire to the back terminal, and the back electrode is connected with the frame of the instrument, which forms the other terminal.

The "solid back" transmitter possesses the following advantages over many other types of transmitters :—

(1) The instrument does not become unduly heated when worked with heavy currents.

(2) The special construction of the carbon chamber eliminates "packing" of the granules.

The resistance of the instrument is 55 ohms.

THE B.T.-H. STAND AT THE PRESTON EXHIBITION.

The business value of local electrical exhibitions has often been demonstrated. The most recent of these exhibitions, namely, the one held at Preston from March 10 to 14, was extraordinarily successful, both from the point of view of the advertiser and also from that of the individual exhibitors.

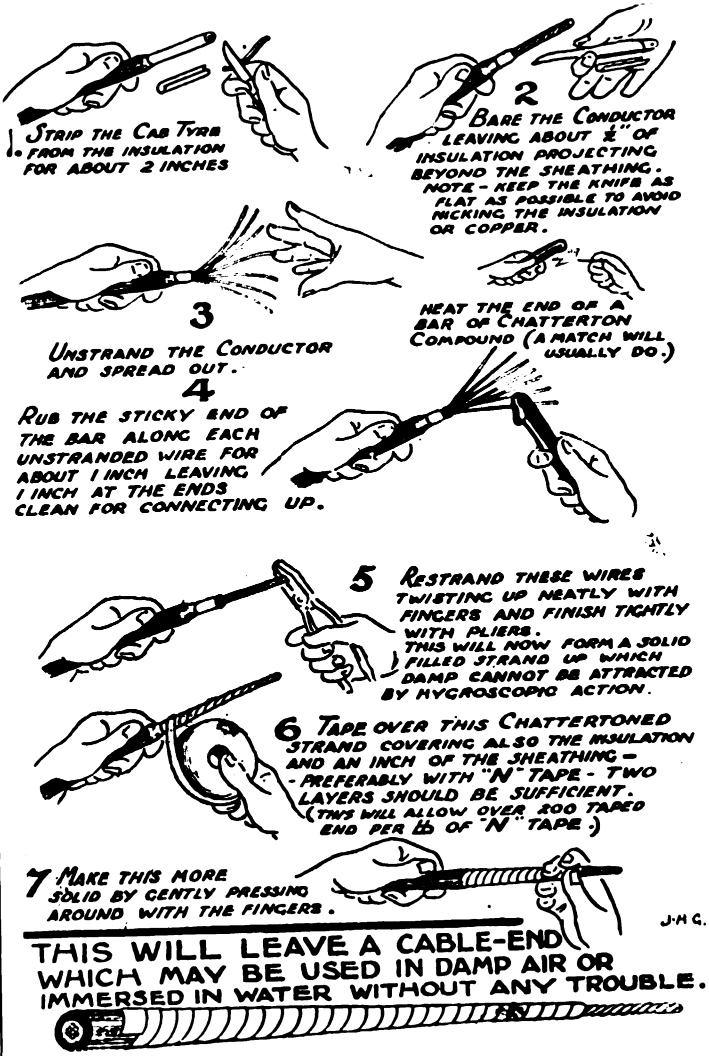
B T-H
The British Thomson-Houston Co Ltd
B T-H
The British Thomson-Houston Co Ltd
Local Branch 14 South Castle St Liverpool
MAZDA

One of the most noteworthy exhibits was that of the British Thomson-Houston Company, whose stand was in itself a most comprehensive exhibition of good lighting appliances. Here were shown the most important of the many B.T.-H. lighting specialities, including Mazdalux reflectors, various domestic lighting fittings, glassware, etc., while Mazda lamps themselves were represented by displays of showcards and the attractive blue and orange packages in which the lamps are contained.

The stand was most attractive and interesting in its general appearance, as the accompanying illustration shows, and produced a great many inquiries from visitors to the exhibition. Needless to say, all inquiries from the public were referred to local retail suppliers.

PROTECTING CABLE ENDS FROM MOISTURE.

In using Cab Tyre Cables, which for many purposes offer important advantages, especially when located in damp positions, as on wharves, in mines, in tunnels under construction, or in exposed buildings, etc., where the conditions involve, frequently, contact with moisture and condensation, the makers, the St. Helens Cable and Rubber Co., of Slough, point out the importance of protecting the bared ends in a way to prevent deterioration or the lowering of the high insulating qualities claimed for this class of cable, and they have issued a leaflet illustrating in clear detail the simple processes to be followed to ensure this result and which we here reproduce.


1. STRIP THE CAB TYRE FROM THE INSULATION FOR ABOUT 2 INCHES
2 BARE THE CONDUCTOR LEAVING ABOUT ¼" OF INSULATION PROJECTING BEYOND THE SHEATHING. NOTE - KEEP THE KNIFE AS FLAT AS POSSIBLE TO AVOID NICKING THE INSULATION OR COPPER.
3 UNSTRAND THE CONDUCTOR AND SPREAD OUT.
HEAT THE END OF A BAR OF CHATTERTON COMPOUND (A MATCH WILL USUALLY DO.)
4 RUB THE STICKY END OF THE BAR ALONG EACH UNSTRANDED WIRE FOR ABOUT 1 INCH LEAVING 1 INCH AT THE ENDS CLEAN FOR CONNECTING UP.
5 RESTRAND THESE WIRES TWISTING UP NEATLY WITH FINGERS AND FINISH TIGHTLY WITH PLIERS. THIS WILL NOW FORM A SOLID FILLED STRAND UP WHICH DAMP CANNOT BE ATTRACTED BY HYGROSCOPIC ACTION.
6 TAPE OVER THIS CHATTERTONED STRAND COVERING ALSO THE INSULATION AND AN INCH OF THE SHEATHING - - PREFERABLY WITH "N" TAPE - TWO LAYERS SHOULD BE SUFFICIENT. (THIS WILL ALLOW OVER 200 TAPED END PER lb OF "N" TAPE.)
7 MAKE THIS MORE SOLID BY GENTLY PRESSING AROUND WITH THE FINGERS.
J.H.G.
THIS WILL LEAVE A CABLE-END WHICH MAY BE USED IN DAMP AIR OR IMMERSED IN WATER WITHOUT ANY TROUBLE.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 180.

Can any reader inform me how I can obtain the value of the inherent reactance of an alternating current generator? I have no particular make of machine in mind, but current limiting reactances interest me and I cannot get any technical details.—" H. B. HURRY."

QUESTION NO. 181.

I wish to make up a condenser for a home-made wireless set with mica and tin foil. Can any reader give me constructional details, *i.e.*, thickness of mica, quantity of tin foil, and precautions to be taken?—" E. J. MORTON."

(Replies to Questions Nos. 180 and 181 must be received not later than May 31, 1924.)

Answers to Questions.

QUESTION NO. 177.

I am in charge of a large D.C. motor plant, and I wish to design a starter that will start, in case of emergency, any motor from 5 h.p. to 75 h.p. Can any reader give me some helpful suggestions which can be embodied in the design?—"TESTER."

REPLIES TO QUESTION NO. 177.

The first prize (10s.) has been awarded to " M. M." for the following reply:—

The writer suggests an arrangement consisting of *one* common resistance with *five* switches. We will suppose the supply voltage is 440.

The first switch to start the 5 h.p. motors; the second —10 and 15 h.p.; the third—20, 25 and 30 h.p.; the fourth—35, 40, 45 and 50 h.p.; the fifth—55, 60, 65, 70 and 75 h.p. It would scarcely do to start 5 and 10 h.p. motors by the same switch; this would mean an increase of 100 per cent. By grouping as above, and taking the mean current of the group, each of the other four groups will not require its switch to carry more than an overload of about 3 per cent. Suppose that the current when on first contact of any switch is not to exceed 10 amperes, then the resistance will be 440 ÷ 10 = 44 ohms.

Consider now the group of largest motors. The best method of dividing the resistance will be by grading the parts in a geometrical progression. The ratio may be found from the formula:

ar^n = resistance in ohms.

where a = armature resistance—in this case the mean of the five, say ·11 ohm.

r = the geometrical ratio.

n = number of divisions in the resistance; this we will take as ten.

$$\text{then } .11\, r^{10} = 44$$

$$r^{10} = \frac{44}{.11} = 400.$$

$$\log r = \frac{1}{10} \log \text{ of } 400.$$

$$= .260206.$$

$$\therefore r = 1.8205.$$

Neglecting the 05, multiply the armature resistance by 1.82 and we have .2002. This is the resistance of the armature plus that of the division next armature. Therefore, this division = .2002 — .11 = .0902 ohm. Multiply this by the ratio and we have .0902 × 1.82 = .1641, which is the resistance of the second division. The third division is .1641 × 1.82 = .2987 ohm. And so on for the 10 divisions. The sum of these will be approximately 44 ohms.

The divisions for the other switches may be obtained in a similar manner.

It will be recognised that the electrical values on which the above calculation is made would probably require modification in order to suit local conditions.

The whole combination could be mounted on a portable iron frame and taken to any position where required.

If intended for testing motors, the resistance and switches could be fixed on a wall.

The switches could be quite simple affairs, as it would in such a case be convenient to have the shunt winding fed by a different circuit.

A liquid starter, two iron plates in a solution of sodium sulphate, might be worth consideration. Such a starter, overall dimensions about 20 in. × 18 in. × 6 in., would provide a cheap method for the purpose.

M. M.

No second award is made.

Czecho-Slovakia.—The report on the industrial situation in this young Republic has just been issued by the D.O.T., and may be obtained from H.M. Stationery Office or ELECTRICITY Office, price 1s. 7d. net post free. As usual, it contains much matter of interest to all who wish to push trade with these new nationalities.

Meetings.—The next regular meeting of the Western Centre of the I.E.E. and the first joint meeting with the Assocn. of Mining Electrical Engineers (South Wales Branch) will be held at the new electric power station of the West Gloucestershire Power Co., Lydney, at 3.30 p.m. on Saturday, May 3, when Prof. W. M. Thornton will read a paper on "Some Researches on the Safe Use of Electricity in Coal Mines," which will be illustrated by exceedingly interesting experiments.

The Story of Coal.—In 1913 the average output per worker employed in British mines was 258 tons; in 1915, 265 tons; in 1920, 182 tons; and for 1923 it was estimated at 223 tons. The output per worker in North America was 681 tons in 1913; 786 tons in 1918; and 743 tons in 1920. Previous to the war, less than 9 per cent. of British coal output was machine mined, compared with 43 per cent. in North America. Since the war, about 25 per cent. of Scottish coal is machine mined, but only 2 per cent. of Welsh

Tenders Accepted.—The Admiralty have placed an order with the Siemens and English Electric Lamp Co., Ltd., for the supply of a large quantity of Siemens gasfilled lamps for the various dockyards.

Why Not Here?—From 1912 to 1923 the number of houses supplied with electricity by one Canadian company alone increased by over 400 per cent. In the town of Windsor, Ontario, out of a total of 7,500 homes, 2,500 have been fitted with electric cooking ranges within the period named.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of

CORRECT ARTIFICIAL LIGHTING

Advert of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

Train Lighting.

Once more we have the moral of a deplorable railway calamity, accompanied by fire, involving the wreckage and imprisoned victims, to emphasise the urgency of eliminating gas for railway-carriage lighting. In the recent Continental disaster the German train carried the usual gas cylinders and the escaping gas ignited, causing far greater danger and loss of life than would otherwise have occurred. In this country the electrification of rolling stock is proceeding satisfactorily, and most of the more important trains are already equipped. Let us hope that British railway authorities will do all possible to urge forward the remaining conversions, so that this recurrent danger is dispensed with. It is bad enough to be seriously injured by impact without the ever-present risk of being slowly roasted to death afterwards.

Wembley.

From the official opening day great strides have been made towards completing the unfinished details of the great Empire Exhibition, and although much yet remains to be done, there is plenty to interest the visitor and distract his attention from the unfinished sites which remain here and there. At the time of writing one of the most serious handicaps, experienced alike by the exhibitors and amusement caterers, is the shortage of "juice." Many of the stands are still without a supply of current, nor can any definite information be obtained from the authorities when the emergency is likely to be met. It is easy to criticise, of course, but abundance of electricity is essential to the success of many of the exhibits, to say nothing of effective illumination, and the earlier the deficiency is remedied the better for everyone concerned.

Probably the most serious inconvenience is that attendant upon the users of storage batteries for various purposes, as, unless the stallholder is in the happy position of possessing his own charging plant on site, there is nothing for it but to transport the batteries to and from Wembley as and when required. I know of several casualties which have already happened to glass containers as a direct result of this essential practice. By contrast, the gas interests appear to have made greater headway, the gas exhibit in the Palace of Industry being quite a blaze of light after sunset; it is certainly their opportunity, and they are making the most of it.

The telephone service also at present leaves much to be desired, and has apparently not yet got into its stride. At the outset there was a shortage of junction lines with the London exchanges, and the almost invariable reply to a call for some time was "junction engaged." In the circumstances it is a pity that the rapid automatic service now being demonstrated at the Exhibition could not have been installed in time for the Exhibition services. It would certainly have overcome many of the disabilities now being experienced. However, these little troubles will doubtless right themselves in good time, when the greatest show on earth settles into its stride.

The broadcasting of the opening speeches was a huge success, and the new loud-speakers installed throughout the grounds enabled everyone who was not fortunate enough to be within the Stadium to hear what was going on. In this connection we are asked by the Western Electric Company to correct some of the misleading statements which have been made concerning the apparatus used for this purpose. The only apparatus employed for the broadcasting of the speeches and music to the 150,000 people in the Stadium was designed, manufactured and installed by that company, who are to be congratulated upon the very successful results obtained. I personally heard every word of both the King's and the Prince's speeches from the loud-speakers installed on the railway viaduct, and can vouch for the perfection of the transmission, which, after all, is the fundamental basis of successful broadcasting.

Standard Contract Conditions.

The Council of the Institution of Electrical Engineers have issued a model form of general conditions, intended to cover the main conditions for home contracts for the sale of goods and materials, other than cables, without erection; together with a model form of general conditions intended to cover the main conditions for home contracts for the sale of cables without erection. It is hoped that in order to secure the advantage of uniformity and to avoid trouble and expense, they may be found suitable in their entirety for the majority of home contracts. Uniformity in contract conditions wherever practicable is highly desirable as tending to eliminate much irritating and vexatious argument, both before and after the completion of the sale, and it is to be hoped that the conditions will be adopted by the leading cable makers. Copies may be obtained from the Secretary of the Institution, Savoy Place, Victoria Embankment, W.C.2, as well as from Messrs. E. and F. N. Spon, at sixpence per set, post free.

Electromobiles.

With the exception of the heavier type of delivery van and the smaller railway platform luggage truck, there has been comparatively slow development of the self-contained battery-driven electric vehicle in this country. In the circumstances, the miniature electric 'buses which have been placed in service for transporting visitors round the Exhibition grounds are of more than passing interest, and should constitute a good test of the capabilities of this form of transport for certain special services. These little vehicles are low built and accommodate twelve passengers besides the driver, who, by the way, does not appear seated in the best possible position with regard to his controls. They are essentially slow-moving vehicles, and would appear admirably adapted to the purpose for which they are intended.

While on the subject of electric vehicles, it is perhaps not out of place to recapitulate their advantages, some of which are apt to be overlooked by those who have given no thought to the question. My esteemed contemporary, *Municipal Engineering*, thus summarises the principal outstanding characteristics of this class of vehicle:—(1) Ease of manipulation; (2) economy in operation and maintenance; (3) simplicity of construction; (4) elimination of energy waste; (5) smoothness of operation; (6) absence of exhaust gases; (7) self-starting quality and rapid acceleration; (8) minimised danger of fire; (9) low rate of depreciation; (10) good weight distribution; and (11) reliability. There are other advantages attaching to the electric vehicle in special circumstances and according to the services for which it is required, but the above list serves to indicate that its development in this country up to the present has only touched the fringe of its possible applications.

Wireless Light.

If report speaks truly, we are within measurable distance of bridging the gap which at present separates the radio frequencies from those of a higher order associated with light. According to an advice from New York, negotiations are being conducted with a view to demonstrations at the First Radio Exposition there next September of an alleged discovery by two French radio experts—General Jouaust and Major Mesney—of a means of transforming light waves from a star into audible sounds. If the negotiations are successful, a fully equipped high-power testing station will be installed in the tower of Madison Square Garden for the exclusive use of the inventors, and an assistant committee appointed to further develop the discovery. Reports of recent lectures by General Jouaust and Major Mesney at the Paris Academy of Science have already aroused considerable interest, and further developments will be keenly awaited.

Noisy Meters—

Most of us, I think, regard meters in general as very quiet and retiring pieces of apparatus. Still, I remember a water-type gas meter at home in my youthful days which occasionally would utter a most melancholy sort of gurgle. This always happened when it was dark and I was alone in the house; on one occasion I was so terrified that I left my post of duty beside my sleeping younger brother and awaited my parents' return in the comparative security of the street. And then there are those hefty meters which measure the water input to power stations and the like. These seem to have a special kind of thumping noise of quite a big order.

But the ordinary electric house-service meter is apt to be regarded as harmless in this respect. However, while direct-current ones seem to bear a blameless character (to make up for other shortcomings, I expect), alternating current ones can prove a nuisance—fortunately not often. Lately the supply company with which I am connected has had quite a lot of trouble with some exasperating specimens, mostly from a recent batch just calibrated and installed. In the test-room the meters were silent, or appeared silent. When they were in position on their boards (which acted as good *sounding*-boards), and at, say, the dead of night, a hitherto unnoticed hum became very much apparent. This might happen when no current was flowing. The cause was generally the laminated pole of the pressure coil; if indifferently riveted or otherwise poorly secured, the alternations would make the loose laminations vibrate at the supply frequency, and given the right conditions the little noise could become formidable.

—And a Musical One.

Curiously enough, one perplexing meter steadfastly refused to make the slightest sound when brought back, although *in situ* it thoroughly annoyed the consumer. Another meter was so noisy that the inspector heard it as soon as the front door was opened to him; it *was* said afterwards that the meter put the loud pedal on specially at this moment—the inspector, I might add, was already more than "fed-up" with noisy-meter faults. One of the test-assistants obtained a clue in rather a diverting way. His maternal relative returned from a mothers' meeting with the news that two of the ladies from one street had been comparing notes about their humming meters. The strangest incident, funny and yet pathetic, occurred in a house where a man lay on a sick bed. One morning the doctor called when the patient, after a night of delirium, was still somewhat dazed. When asked how he felt, the patient replied that he "could not stand the gramophone on the wall playing 'Onward, Christian Soldiers.'" Need I say what the "gramophone on the wall" was?

The Faraday Medal.

The presentation of the Faraday Medal of the I.E.E. to Dr. Ferranti on Thursday, April 24, was a worthy acknowledgment of a lifetime of work in the promotion of electrical engineering science and practice in its broadest sense, with the added pleasure of knowing that the recipient is of an age that may lead us to hope for many more years of his inventive abilities. The speeches by Col. Crompton, Mr. Partridge and Dr. Russell, the president, were in the happiest vein, and Dr. Ferranti's modest reply, stating that he hoped to do much more for the industry, was received with enthusiastic applause. This pleasant ceremony was followed by the fifteenth Kelvin Lecture, which was delivered by Mr. G.

Semenza, of Milan, and dealt with the subject of "Kelvin and the Economics of the Generation and Distribution of Electrical Energy." It was a clear exposition of the debt of the present generation of electrical engineers to the great scientist for his enunciation of laws and rules which have gone far to assist the development of the transmission of electric power at the present day, and was accompanied by some most interesting diagrams. At the conclusion of the lecture, Mr. Morley was truthfully able to compliment Mr. Semenza on the technical value of the paper, and also on the excellence of the English in which it was rendered. He was supported by Mr. Roger J. Smith, another past-president, and backed up by the universal opinion of all present.

Wembley and the C.T.O.

I am very pleased indeed to see that at least one paper, the *Evening Standard*, has mentioned the name of Mr. Cruickshank, the official who was responsible for sending round the world in eighty seconds the message in the King's name announcing that the opening had taken place. I have a wide circle of telegraph readers who are certain to be interested in this telegraphic feat, and I hope that, in due course, fuller particulars will be given in our editorial columns. In the meantime, I am sure we can all congratulate Mr. Cruickshank on his success, as it seems to have appealed to the popular imagination and raised the telegraph messenger into a sort of hero. Mr. Cruickshank is a member of the Institution of Electrical Engineers, and, in addition to his official duties in the Engineering Department of the G.P.O., he is the editor-in-chief of the *P.O.E.E. Journal*, which is published every quarter. I might also add that it was he who edited and revised the current edition of that well-known textbook *The Telegraphists' Guide*, from which many thousands of telegraph engineers now in high positions gained their early knowledge of the science.

Elektron.

"SOME IDIOSYNCRASIES OF ELECTRICAL MANUFACTURERS."

At the meeting of the Informal Section of the I.E.E. on Monday, April 14, Mr. W. E. Warrilow was in the chair when Mr. J. R. Bedford opened a discussion on this subject. Taking as his text an expression he had often heard, "Oh, that the designers of this gear had the job of installing it," Mr. Bedford detailed a number of instances where the manufacturers don't give sufficient attention to design. The importance of keeping down works costs very often results in a lack of finish or spacing that is very expensive in ultimate cost to the user.

Referring to the Wembley Exhibition and the hopes we have of stimulating foreign and Colonial business, Mr. Bedford hoped the experiences of the home buyers in many instances would not be those of the overseas buyers of British goods.

A record number of speakers joined in discussing Mr. Bedford's paper, and the opinions of the user, contractor and manufacturer were all voiced.

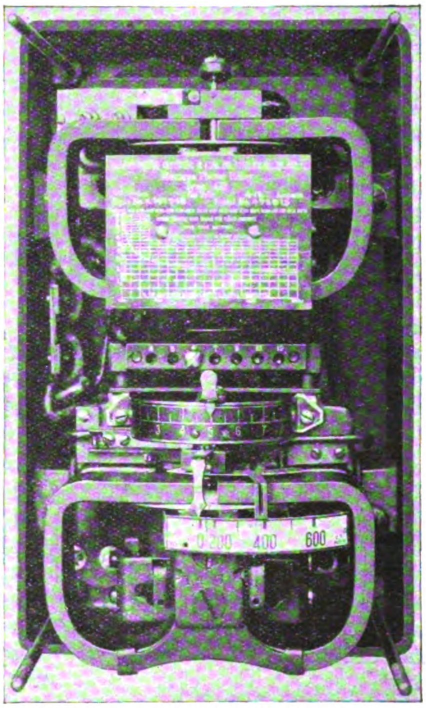
Messrs. J. F. Avila and P. Rosling gave instances of the way production is harassed by the imperative need of keeping costs low. Nobody likes mean work or giving ungenerous service, but it is the nature of the buyer to object even more strongly to paying for service.

Messrs. H. Brown, J. T. Bedford, J. Coxon, W. Day, D. Dixon, V. N. Halliday, A. F. Harmer, A. G. Hilling, R. V. Hook, A. Kirk, C. F. Mounsdon, F. Pooley, W. Riggs, W. E. Rogers, F. P. Sexton, W. E. Twells, W. E. Warrilow, M. Whitgift and W. L. Wreford also spoke.

This was the concluding meeting of a very successful session. The papers have been of a high standard and the discussions have been well maintained, with an average attendance of over 50.

NEW RELAY HAS SELF-CONTAINED AMMETER.

A line of overcurrent and directional relays equipped with a current-indicating element is a product of recent work by the American Westinghouse Electric and Manufacturing Co. in the field of protective devices for electrical circuits. These relays, known as COA and CRA, differ from the standard Westinghouse CO and CR overcurrent and directional relays in that they have self-contained ammeters which give a continuous indication of the current flowing in the circuit to which the relay is connected. They are designed for use where the relays are mounted on the front of a switchboard and where there is insufficient room to provide separate ammeters. Particularly are they desirable where it is considered advisable to have continuous supervision over the current circuit of the relay.



Westinghouse Type CRA Directional Relay.

In addition to operating as protective relays, these relays indicate the current flowing through the relay circuit, which not only shows the current in the feeder, but also proves to the operator that the relay is receiving current through its circuit, and is therefore in condition to operate if a short circuit should occur.

The indicating element of this new relay consists of a thin copper disc mounted on a separate shaft and having its own jewel-bearing and control spring. It is actuated, however, by the same flux which operates the main disc to close the contacts of the relay. This prevents the indicating element from operating when there is any trouble either inside or outside the relay that would prevent the main electro-magnet from being energised.

ELECTRIC DRIVING OF A MODERN FACTORY.*

By F. W. Smith, N.A.S.E.

(*Continued from page 222.*)

Power Required.

It is difficult in the time at our disposal to adequately deal with the power actually required for the various printing machines. You will realise this when I say there are over 250 different machines, all of which are designed for some special work, and each having its own particular drive. These machines are divided into groups and are known as:

- Wharfedales.
- Fine Art Wharfedales.
- Perfectors.
- Two Colour.
- Miehle (English).
- Miehle (American).
- Huber Perfector.
- Perceler.
- Two Feeder Perceler.
- Flat Bed Lithos.
- Rotary Lithos (English).
- Rotary Lithos (American).
- Rotary Offsets, Single Colour.
- Rotary Offsets, Two Colour.

These are not all by any means, but will suffice for the purpose of this paper. The following is fairly representative of the power required to drive some of these machines.

Wharfedale Machines.

Machine	Horse-power.
Crown	1
Royal	1½
Double Crown	2¼
Double Demy	2½ to 3
Double Royal	3 to 4
Quad Crown	4 to 4½
Extra Quad Crown	4 to 4½
Quad Demy	5
Quad Royal	5 to 6
Eight Crown	6½
Eight Demy	8

Fine Art Wharfedales.

Machine	Horse-power.
Demy	3
Royal	2½
Double Crown	3
Double Demy	3 to 4
Double Royal	4
Quad Crown	5 to 6
Quad Demy	5 to 6
Quad Royal	7

Perfectors.

Machine.	Horse-power.
Double Demy	4
Double Royal	4½
Quad Crown	5
Quad Demy	5 to 6
Quad Royal	6 to 8
Eight Crown	11

Two Colour.

Machine.	Horse-power.
Double Crown	4
Double Demy	4½
Double Royal	6
Quad Crown	7½
Quad Demy	10½
Quad Royal	11

Miehle Machines (English).

Machine.	Horse-power.
No. 4	3
No. 3	4
No. 1	4½
No. 00	5½
No. 0000	5½
No. 000000	6½

Miehle Machines (American).

Machine, 4-roller.	Horse-power.
No. 1	4½
No. 2	3½
No. 2/0	4½
No. 3	3½
No. 4	3
No. 4/0	6
No. 7/0	8

Perceler.

Machine.	Horse-power.
Double Demy	4
Double Royal	5
Quad Crown	6½
Quad Demy	8
Quad Royal	10½

Two Feeder Perceler.

Machine.	Horse-power.
Quad Crown	9
Quad Demy	12½
Quad Royal	16

The speed of the motor is decided by the minimum and maximum impressions per hour of the printing machine. For instance, assuming we wish to run the press from 800 to 1,200 impressions per hour, we have first to find the number of revolutions of the back shaft or driving shaft of the machine per impression. One of the easiest ways is to turn the flywheel until the bed of the machine is right out, and just on the turn, then stick a piece of paper on the flywheel and count the number of times it revolves before the bed comes back to its original position. This will give the ratio. Now if we multiply this by the desired impressions per hour, and divide by 60, we get the speed of the back shaft per minute, *i.e.*,

$$\frac{\text{Impressions per hour} \times \text{ratio}}{60} = \text{r.p.m. of back shaft.}$$

You will agree, I am sure, that there is no need for me to apologise for giving these elementary calculations, when I remind you that the primary object of this Association was that of education for its younger members; and in view of the fact that we have a large number of associates who are drawn from all branches of the electrical industry, it is hoped that these figures will be of some use to them.

---

* Lecture delivered before the N.A.S.E.

(To be continued.)

A UNIVERSAL METER FOR ELECTRIC POWER.

By B. H. Smith,
(Supply Engineering Department, Westinghouse Electric and Manufacturing Co., U.S.A.).

One of the principal reasons for the somewhat unsettled state of the art of metering large quantities of electric power is the fact that there has been available no completely satisfactory and universal meter. The watt-hour meter is a wonderfully reliable and satisfactory device and for ordinary residence service there is probably nothing that could be more suitable; but with the larger quantities of power that are used by mills, factories, stores and for various industrial applications, as well as for measuring the interchange of power between different power companies whose lines are interconnected, other factors than watt-hours must be taken into account. Polyphase alternating current circuits carry most of the electrical energy today, and in such circuits the relation between voltage, current, power factor, etc., are complex, and yet must be considered in the buying and selling of electric power.

The purpose of this article is to describe a new k.v.a. meter especially well adapted for billing data on large power circuits. It gives direct reading of indicated power factor, total kw. hours, total k.v.a. hours, and kw. and k.v.a. demand for any pre-determined time interval; and the power factor for any time interval, particularly at the time of maximum demand, can be readily obtained. With this information practically any kind of power contract can be taken care of.

One of the most important uses of this new meter from the standpoint of large industrial users of power is in connection with power-factor correction by means of either synchronous machines or static condensers. Power factor is the ratio of power current to total current flowing in a circuit. When the voltage and the current become out of phase, the current may be considered to be made up of two currents, one in phase with the voltage and the other 90 degrees out of phase with it. The out-of-phase current is called the reactive or wattless component. It is stored energy being transferred back and forth through the circuit with no resulting losses except the heat losses due to resistance. This loss occurs in the line and all current carrying parts. When the power factor becomes low. large amounts of energy are expended in heating up conductors that would, under proper operating conditions, be available for useful work.

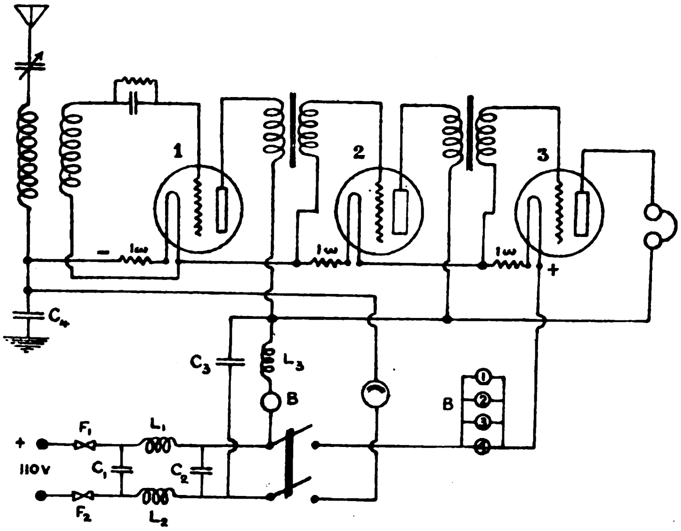
Low power factor operation results in increased losses in generators, exciters, distribution lines, transformers, and in the consumer's plant. In a system working at 70 per cent. power factor, the losses are twice as great as if it were working at unity power factor. This loss is caused by increased currents for the same amount of power, and stronger fields are needed by the generators to furnish this power, which causes undue heating.

The power factor of a plant can be improved to some extent by the arrangement of the motors, so that they will operate at more nearly full load. It is usually impossible to secure good power factor conditions without the use of some corrective device, but the magnetising k.v.a. should, for obvious reasons of economy, be reduced to a minimum before installing these corrective devices. The substitution of a few comparatively large synchronous motors in place of induction motors where conditions are suitable often makes the most economical method of improving the power factor. But the usual application is best met by the simple squirrel cage induction motor, and it is common practice to obtain the desired power factor for the plant by installing a few synchronous units or static condensers, whichever is best adapted to local conditions.

(To be continued.)

RADIO RECEIVING CIRCUIT TAKING POWER FROM LIGHTING MAINS.

The use of valves and a loud-speaker involves comparatively frequent recharging of accumulators, and, in order to avoid the trouble and expense thus involved, various attempts have been made to utilise directly a supply from lighting mains. The circuit shown in the accompanying diagram is recommended by *Hamburger Nachrichten.* It is claimed that any disturbance which might be caused in the lamp circuit of the receiver by the power current circuit can be eliminated by a combination of coils and condensers L_1, L_2, C_1, C_2. The condensers must, however, have a capacity of about 10 microfarads, and may be built up from telephone condensers of 2 mfd. each.



As a protection against short-circuit, the connection to the mains is made through 5-amp. fuses F_1, F_2. The current flowing through the receiving valves connected in series can be adjusted to the correct value by interposing the appropriate number of 10, 15 25 or 160 watt lamps (B_1—B_4). The condenser C_4 in the earth connection of the receiving apparatus prevents short-circuit in the event of the power circuit being earthed accidentally or intentionally; this condenser may be of 2 mfd. capacity, and of the construction used in telephone practice. Whilst preventing completely the passage of direct current through it, this condenser does not affect reception of the radio-frequency current.

The valve filaments are connected with the negative pole of the power supply, and the greater part of the energy expenditure occurs in the series lamps. The plate current is derived from the same supply, and it is recommended that a coil and condenser be used here as well to exclude noise. A 10-watt tungsten lamp in the plate-current circuit normally causes only a small pressure drop, but, in the event of a short-circuit on the plate leads, the lamp burns and limits the current to about 0.1 ampere.

Those of our readers who have facilities for setting up experimental circuits will doubtless be interested in the arrangement depicted, and their experience in its operation would be of value to others if discussed in these columns.

TENSILE STRENGTH AND ELECTRICAL RESISTANCE OF COPPER.

An interesting note, of practical value, was presented by W. E. Alkins at the recent general meeting of the Institute of Metals. The author described two series of experiments which were carried out with the object of investigating the relationship between the tensile strength of commercially pure copper as it is hardened by wire-drawing and the accompanying increase in its resistivity. Two samples of copper of high purity from imported wirebars were used. In the case of each sample a number of test lengths, varying in hardness from thoroughly annealed to hard-drawn (tensile strength from about 16 up to about 30 tons per sq. in.) were obtained by varying the method of preparation. Resistance determinations were made on nominal one-thirtieth of a mile lengths, using a five-dial resistance box. The temperature variation was kept as low as possible during the determinations.

The results show that the relation between the tensile strength and the percentage increase of the resistivity as compared with the annealed wire is reasonably rectilinear when the tensile strength exceeds 20 tons per sq. in., and it is suggested that the resistance (R_T) of any given wire of tensile strength T tons per sq. in. should be taken as :—

$$R_T = R_a\left(\frac{100+\frac{T}{10}}{100}\right)$$

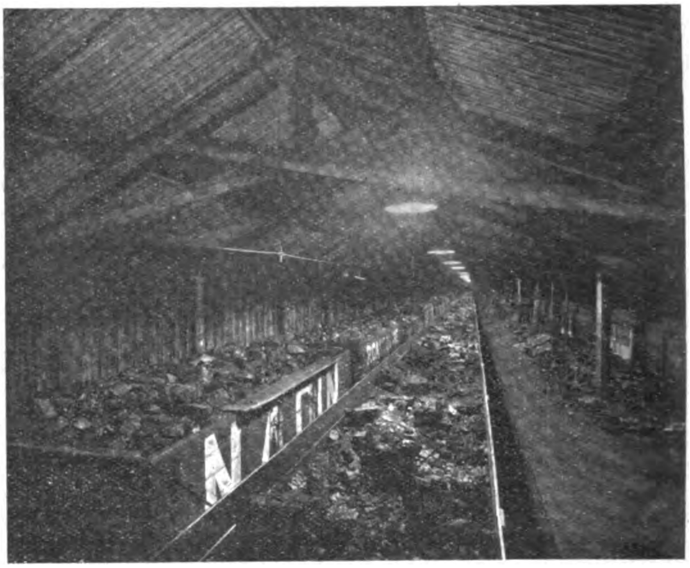
where R_a = the resistance of a similar annealed wire corresponding to the international standard.

In other words, the resistance of a hard-drawn copper conductor is p per cent. higher than that of an annealed copper conductor of the same size where $p = T \div 10$, and T = the tensile strength of the hard-drawn wire in tons per sq. in. This result is easily memorised and of considerable practical utility.

Young people are not half so bad as they would like to make their elders believe

OSRAM DAYLIGHT LAMP FOR LIGHTING SCREENS IN COLLIERIES.

The separation of dirt and foreign matter from coal during transportation to the screen, which is usually carried out while the coal is being carried on conveyor belts and at fairly rapid speed, is rendered much more efficient and easy during the hours when artificial light is needed by the adoption of super effective lamps as has been clearly demonstrated in cases where "Osram" daylight lamps have been introduced, the work being done equally efficiently over the whole period of 24 hours. In the illustration reproduced, which refers to the Anley Colliery, near Coventry, 300-watt Osram lamps illuminate a belt about 250 feet long, spaced approximately five yards apart, and about two yards above the belt surface. The lamps are hung with auto-vibrator shackles. There is little glare, and the workers carry out their duties in comfort and with speed and accuracy.



Reviews of Books, &c.

[Books noticed in this column will be sent from ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

THE ROMANCE AND REALITY OF RADIO. By Ellisor Hawkes, Editor of the "Meccano Magazine." (T. C and E. C. Jack, Ltd., 3s. 6d. net.)—This book is an attempt to bring before the non-technical reader a brief account of the historical, theoretical and practical aspects of the important and growing science of radio. As such it fulfils its purposes and is well written and illustrated.

As one would suppose, the constructional part deals with the assembly of Meccano parts for wireless reception.

The broadcasting station list requires modification, as wave-lengths, etc., have been amended since publication of the work.

Nearly all the aerial diagrams are incorrect, as the lead-in wires are not shown at the *ends* or *end* of the "roof" portion. We are not, of course, referring to the T aerial illustrations, although even here it is not emphasised that it is necessary, in theory at any rate, to find the exact middle of the "roof" wires to which to attach the lead-in wires.

An inverted aerial constructed as shown has obviously two natural wave-lengths, and must therefore be to some extent inefficient and non-selective.

WIRELESS OF TO-DAY. By Charles R. Gibson, F.R.S.E., and W. B. Cole, A.M.I.E.E. (Seeley, Service, 7s. 6d. net.)—We welcome one of the most interesting and instructive books on this subject that it has been our pleasure to read. So many popular books have been written on the growth, advance and present position of wireless telegraphy and telephony, that the possibility of writing something new on such a subject appears to be remote. Mr. Charles Gibson is a skilful writer on all matters scientific, and has the happy knack of making the difficult things plain without departing at all from their scientific value. As the author of a book on wireless published in 1914, Mr. Gibson cannot be said to be "new to his subject," and in collaborating with Mr. Cole he has brought into his work the most up-to-date experience available. The book is over 300 pages of good solid scientific knowledge, and is written with a swing that makes its reading a pleasure. Starting with a chapter on ether, it concludes on listening-in, and both these chapters and those between fulfil the book's title, and the illustrations are numerous and adequate. To many the final chapter, "Some interesting dates in the development of wireless telegraphy," will be very welcome. Here in chronological order are given the dates and particulars of inventions and discoveries connected with the science, since Michael Faraday discovered magnetic induction in 1831 down to the erection and operation of broadcasting stations in 1923. It is an ideal book on the history and the how and why of wireless, and we strongly recommend it.

TELEPHONY. By T. E. Herbert, M.I.E.E. (Pitman, 18s. net.)—Intended by its author as a text-book for City and Guilds students, and, therefore, necessarily including voluminous detail not closely associated with the art of telephony pure and simple, this volume by the same writer who produced the classic text-book on telegraphy is frankly disappointing.

Like many other books written by Post Office engineers, it inevitably reflects departmental practice, cut-and-dried methods and nomenclature, a fact which, although doubtless recommending it to intending entrants for the Civil Service, does not mark the work as an outstanding treatise on one of the most complex applications of electrical science.

Thus out of a total of some 840 pages, no fewer than 212, embracing the first eight chapters of the book, deal solely with fundamental electrical principles and constitute, in effect, a long-drawn-out introduction to the real subject matter of the book—telephony. Admittedly a general knowledge of these underlying principles is essential to the student, but to include them in detail in a text-book on telephony itself marks an endeavour to cover too wide a field in one and the same work, a mistake common to many writers on this subject.

From Chapter IX., which deals with sound, the principles of speech transmission and receivers, onwards, the book deals more fully with the subject of its title, the author adopting the plan of dealing in detail with elementary components, such as transmitters, indicators, keys, plugs and cords, relays, etc., before passing to a discussion of the circuits, switchboards and sub-station apparatus, of which they form part.

The leading systems of manual telephony are described in turn and in terms of Post Office practice, past and present, including magneto, common battery signalling, common battery, private branch exchanges, with their accompanying junctions and trunks.

Power plant, protection and cabling, maintenance and fault testing, are each very fully dealt with in accordance with standard Post Office practice, which largely resolves itself into a matter of established routine, and does not necessitate too exhaustive an understanding on the part of the maintenance staff as to the "why" and "wherefore" of the tests carried out.

As in his companion work on telegraphy, the author deals very fully with line construction, both underground and aerial, a feature which again adds considerably to the scope of the book without being directly associated with the art of telephony. Line construction is now a sufficiently extensive subject to warrant treatment on a separate basis.

Although a final chapter is devoted to the Thermionic Triode, the latest development in long-distance telephony and the improvement of transmission efficiencies, there is no mention of automatic telephony, which is so rapidly displacing the systems described by Mr. Herbert.

The omission is perhaps a praiseworthy one, inasmuch as this subject is even more complex than manual telephony, and fully warrants separate treatment.

Representing a considerable amount of labour on the author's part, this latest handbook will doubtless have a considerable field of utility among City and Guild students, to whose notice we commend it.

FUEL ECONOMY IN STEAM PLANTS. By Arthur Grounds, B.Sc. (Pitmans, 5s. net.)—This is a treatise on the principles and practice of combustion and the conditions affecting fuel consumption. In this small volume the author has certainly condensed a lot of useful information. There are six chapters dealing with principles and practice of combustion, losses in steam plants, economisers and air heaters, boiler management and fuel economy, boiler-house instruments and records. The section dealing with losses due to leakage of air into the boiler settings is very valuable, since this is, probably, the most important subject which interests the central-station engineer. The work is not too profusely illustrated, but this does not detract from its value. It should be in great demand among central-station engineers of all grades.

THE ENGINEERS' YEAR BOOK, 1924. By H. R. Kempe. 31st edition; 2,900 pp.; profusely illustrated. (Lockwood, 25s. net.)—Congratulations to Mr. H. R. Kempe and his associate editors on the careful revisions which have been made in order to keep this standard text-book in line with the current practice. Various alterations and additions have been made in order that modern engineering practice may be standard throughout the volume, and particular prominence has been given to the important sections relating to electrical engineering and electric traction which have had the advantage of extensive revisions at the hands of Prof. S. Parker-Smith, S.Sc., M.I.E.E., whose scientific attainments and intimate acquaintance with these branches of engineering are well known. Altogether, the book maintains the pre-eminence which it has held for so many years, and it remains an indispensable work for every go-ahead engineer.

THE CONTROL OF THE SPEED AND POWER FACTOR OF INDUCTION MOTORS. By Miles Walker, M.A., D.Sc. Cloth quarto, 151 pp., 125 illus. (Benn, 18s. 6d. net.)—Congratulations to Dr. Walker on the publication of yet another of the technical works for which he has gained such a high reputation during the past few years. The steady increase in the growth of the number of induction motors now in use throughout the United Kingdom has caused a demand for technical books dealing more clearly with such items as economical speed control, and when, in addition, the matter of power factor has also to be considered, there is no doubt that a work of this description will find a ready market. It will certainly appeal to all users of electrical power, and, as there is no reason now why a large induction motor should not be run at unity power factor, it will be of direct advantage to engineers in charge of such plant to study this book most carefully. It is remarkably well illustrated with a profusion of clear diagrams as well as excellent photographic reproductions of actual machines built by many of the leading makers in Great Britain, the Continent and in the United States. Not the least interesting chapter is the one dealing with the control of speed and power factor by means of commutating devices, while the thirty odd pages dealing with phase advancers are a perfect education in themselves. We have no hesitation in recommending the book to our readers.

Various Items.

A New Book.—The third and final volume of *Automatic Telephone Systems*, by Aitken, has just been published by Ernest Benn, Ltd. The price is 55s. net, and it can be obtained through the office of this paper.

A Chance for Business.—An important Swiss firm controlling the patents of an electricity meter for which they claim very high efficiency are anxious to arrange for its manufacture in this country. For particulars, see our advertisement pages.

Meetings.—The Junior Inst. of Engineers will meet on Friday, 2nd inst. Lecturette, "Electric Lighting in Churches," by F. H. Taylor, A.M.I.E.E. (Member). Also, on Friday, 9th inst., final meeting of Winter Session. Paper, "Methods of Purifying Water and Sewage," by F. W. Follett (Durham Bursar). Slides. Both at 39, Victoria Street, at 7.30 p.m.

Wages—and Work.—"We are being undersold by the American industries not because our wages are too high, but because production per worker is too low. The American workers get three times the British wage, but then they produce considerably more than three times as much."—J. Ellis Barker, English Financial Expert. (In many industries the Canadian output per worker, and the wages paid, exceed those in the U.S.A. Since the majority of workers are of British birth or descent, it is obvious that the fault is with the methods, not the men.)

Tenders Accepted.—G.P.O. have accepted the tender of the Edison Swan Electric Co., Ltd., for the supply of 12 Tablet Resistances.——Holophane, Ltd., have recently secured the contract for the supply of 3,500 of their Band Refractors for Buenos Aires, while other recent street lighting installations which they have in hand include Bombay, The Hague, Leeds, Manchester, Edinburgh (Princes St.), Glasgow (Gt. Western Rd.), London (Charing Cross District), Blackpool, Warwick and Worksop, as well as an important contract for 2,500 Reflector Refractor units and glassware for 12 schools under the West Ham Education Committee.

Quotations Wanted.—The Borough of Kingwilliamstown invite tenders for electrical plant, steam-raising plant, steel building and high-tension cables.—Specifications, etc., at the D.O.T. (Room 52), 35, Old Queen Street, S.W.1.

Electricity Supply in War Time.—At the next meeting of the Diesel Engine Users' Association, which is to be held on Friday, 9th inst., at the Engineers' Club, Coventry Street, W.1, a paper by Messrs. A. H. Dykes and W. T. Townend on "Electricity Supply in War Time as Affected by the Improvements in Heavy-Oil Engines," is to be read and discussed. The paper deals with the present-day tendency to replace the existing smaller electricity supply stations by capital stations and to the liability of such stations to aerial attack in the event of war. It is anticipated that the reading of the paper will arouse a considerable amount of interest, as the authors suggest a scheme for a number of underground generating stations equipped with Diesel engines. Non-members interested in the subject and desirous of attending the meeting can make application for tickets of admission to Mr. Percy Still, Joint Hon. Sec. of the Association, at 19, Cadogan Gardens, London, S.W.3.

Trade Notes.

A well-printed and profusely illustrated 44-pp. catalogue of conduits and switch fittings has been issued by the **Walsall Hardware Mfg. Co., Ltd.**, of Ablewell Street, Walsall. Included therein are descriptions and illustrations of the new Walsall multiple-grid switch fitting, in which any number of switches from one to twenty are fixed upon one solid grid, and may be lifted clear for wiring; the Walsall watertight interlocking switch plug; Walsall multiple semi-recessed switch fittings; and Ironclad watertight switches, all of which should be of direct interest to installation contractors and electrical engineers generally. We recommend application for copies of the catalogue without delay.

Wireless leaflet 33/24, which has just been issued by **Messrs. D. H. Bonella and Son, Ltd.**, of 58, Mortimer Street, London W.1, deals with their British-made wireless components and crystal sets, which are apparently excellent value at the modest price at which they are listed. They should appeal to all dealers in radio goods.

Pamphlet P188, which has just been issued by the **British Insulated and Helsby Cables, Ltd.**, gives a complete list of the manufactures supplied by the company from their works at Prescot, Helsby and Huyton Quarry respectively, ranging from railbonds to cables, motors to welders, telegraph instruments to batteries, and, in fact, covering almost the entire field of electrical supplies.

GRINDERS
DRILLS
"DEPENDABLE"
& POLISHING LATHES
MARRYAT & PLACE, ENGINEERS.
26 HATTON GARDEN, E.C.1.

Sample Pair Sent on Approval for 8/6
Made of Pure Para Rubber, soft and durable and unaffected by climatic conditions
DAVID MOSELEY & SONS,
Limited,
ARDWICK, MANCHESTER.
MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

MAY 9, 1924.

CONTENTS.

PAGE
Aluminium Conductors 239
A Universal Meter for Electric Power 240
Current Topics 245
Questions and Answers by Practical Men 247
Telephony—Final Grade (Solutions) 247
Development of the Bellini-Tosi System of Direction Finding in the British Mercantile Marine 248
The English Electric Co., Ltd 249
Electric Driving of a Modern Factory 2 9
Automatic Telephones 250
A New Self-Excited Synchronous Induction Motor 250
Various Items 250

ALUMINIUM CONDUCTORS.*

The primary necessity of industry is cheap and reliable power, and, if electricity is to be of use to industry, it must conform to both of these requirements. To be cheap the capital outlay must be kept as low as possible, whilst to be reliable the plant must be mechanically strong and scientifically conceived. Large blocks of power have to be transmitted over great distances, generally at very high pressures, and by the use of aluminium conductors steel reinforced it is possible to build a reliable transmission line at less cost than if copper conductors were installed.

In the first place, a conductor must have sufficient electrical conductivity, or, conversely, should not offer such a resistance to the flow of electricity that more than a certain percentage of the generated power shall be lost in overcoming that resistance of the conductor. Hard-drawn aluminium, as at present commercially produced, has a conductivity of from 60 per cent. to 61 per cent. of the international standard for annealed copper, whilst the conductivity of hard-drawn copper, as used for overhead conductors, is 97 per cent. of this standard. Therefore, the ratio of cross-sectional area of copper to its equivalent in aluminium is 100 to 159. Since the weight of aluminium is 30½ per cent. of the weight of an equal volume of copper, an aluminium conductor having a cross-sectional area 59 per cent. greater than that of a copper conductor, and therefore the same electrical conductivity, will weigh approximately 48.3 per cent. of its copper equivalent. On this account, therefore, aluminium shows a distinct saving in first cost of material, and, by virtue of its lightness, the load imposed upon structures is much less than that imposed by copper conductors. It is well known that, after a period of years, the cross arms on a wood pole line rot out, no matter how well they may be treated with preservative compositions at the time of erection, and, if aluminium instead of copper conductors are used, the vertical load on the cross arm is reduced from, say, 1,000 lb. to 480 lb. This load is, of course, continuous, and by reducing it the length of life of the cross arm is prolonged.

The elastic limit and ultimate strength of pure aluminium, as used for electrical conductors, are less than in the case of copper. It is sometimes found necessary to transmit power at low pressures, especially for direct current work, and this very often involves a large size conductor. For this work aluminium is particularly well suited, in that, although the sag on a big conductor would be greater than in a copper conductor in a long span, it is possible to build an aluminium line with a heavy feeder cable with medium spans without undue variation of sag with temperature. If, however, the power is to be transmitted at higher potentials, with a consequent reduction in the size of the conductor, then the sag necessary to keep the stress on such a conductor within the elastic limit when loaded with ice in the winter would produce a slack line in the summer time. Even with a comparatively small aluminium conductor it is possible, by reducing span lengths to a minimum, to prevent undue sag in the summer time.

For transmission at higher pressures, the highest efficiency is obtained by combining the lightness of aluminium with the strength of high-grade steel. At very high pressures, especially in mountainous country high above the sea level, corona loss plays an important part in deciding the size of conductor to be used, and, as this loss is reduced by increasing the diameter of the conductor, the extra diameter of aluminium steel-cored cable often renders it possible to use a conductor with a lower conductivity, with a consequent saving in first cost. Cables consisting of a steel core, around which aluminium is stranded, have now been tried out in service in such a variety of localities, and under such varying conditions, that their reliability and efficiency have been demonstrated beyond doubt.

It is important that steel wire be galvanised for two reasons. Firstly, the zinc coating which comes between the aluminium strands and the steel core will, in the presence of moisture, prevent electrolytic action between these two metals, and, since aluminium and zinc are close together in the electro-chemical series, no action will take place between them. Secondly, the zinc coating is an additional safeguard against corrosion of the steel.

An aluminium conductor steel reinforced offers particular advantages to the builder of wood pole lines with small conductors. Compared with copper, it is possible, with less sag, and a tension far below the elastic limit of the conductor, to shorten the height of structures and maintain in the conductor an appreciable virtual factor of safety, and, for such work as railway signal lines, important control telegraph or telephone lines, where interruptions are serious, aluminium conductor steel reinforced would give satisfactory operation where copper would fail. On telephone lines, if the small copper wires are strung slack enough to protect themselves under extreme loading conditions, they will be too slack and loopy in hot weather to work satisfactorily under the usual installation conditions where the wires are spaced with from four to twelve wires on a cross arm and several cross arms on a pole, and, in order to overcome this difficulty, it is necessary to string the conductors so tightly that it is by no means uncommon after a snowstorm to hear of miles of telephone lines put out of commission. Aluminium conductors steel reinforced strung with the same sag would not be stressed to their elastic limit under the maximum loading conditions in winter time, whilst in hot weather they would not show undue sag.

---

* Résumé of lecturette delivered before the Junior Inst. of Engineers by Mr. H. G. Williams, Friday, April 25.

In considering the effects of the weather and of the atmosphere on aluminium cables, it must be borne in mind that no metal is entirely unaffected by all conditions which may exist. Hydrochloric acid and strong solutions of caustic soda of potassium will dissolve aluminium. If aluminium cables are installed in localities where vapours of these compounds are present, they will go to pieces in time; also, if aluminium cables are brought into contact with copper or brass wires or clamps and are subjected to moisture, the aluminium will be eaten away by electrolytic action. Galvanised iron or aluminium fittings must always be used. There are many cases of aluminium cables installed over salt water on the sea coast which have been in service for periods of from ten to twenty years without any deterioration whatever. Aluminium cables steel reinforced are in successful service on main-line steam railways, and samples removed after five years' exposure to locomotive flue gases showed no deterioration whatever either of the aluminium or of the steel core. There are also instances of aluminium conductor steel reinforced erected close to coke ovens belching forth sulphur fumes, and, on inspection after seven years' service, it was found that the steel strand and outer aluminium strands were in perfect condition.

There have undoubtedly been troubles due to corrosion of aluminium wires, but, wherever these cases have been thoroughly investigated, the trouble has been found to be due either to the presence of impurities in the aluminium strands, or to contact between aluminium and some other metal, far removed from it in the electro-chemical series, in the presence of moisture Electrolytic aluminium, as now produced for the fabrication of electrical conductors, may be relied upon to resist the action of heavily laden salt-sea atmospheres or of locomotive flue gases.

A UNIVERSAL METER FOR ELECTRIC POWER.

By B. H. Smith,

(Supply Engineering Department, Westinghouse Electric and Manufacturing Co., U.S.A.).

(Concluded from page 235.)

Heretofore it has been impossible to determine the real power factor conditions without considerable difficulty, but with the newly perfected k.v.a. meter the load and power factor conditions over a period of time can be read directly, and when corrective devices are put into service, the improvements in conditions can be recorded exactly. Figures 9 to 13 show how the record chart of the meter changes when the power factor is raised from 70 to 100 per cent.

The foundation of the meter is in a small mechanism which gives a vector addition under all conditions of power factor and load of the quantities which go to make up k.v.a. It is recognised that the most satisfactory method of measuring k.v.a. in a polyphase circuit is by a vector addition of the power and the wattless components of the circuit. In other words, k.v.a. is equivalent to the square root of the sum of the squares of watt-hours and reactive watt-hours. Watt-hours in a polyphase circuit are readily measured with a standard two-element meter, and for practical purposes a similar watt-hour meter may be connected with its voltage coils arranged with a quadrature connection so that for most commercial loads it will give a satisfactory reading of reactive component.

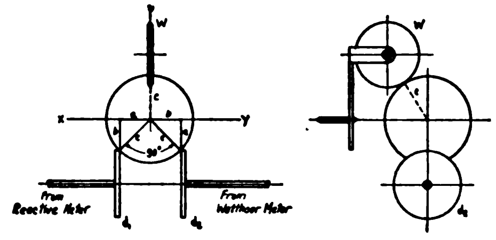


FIG. 1.—70.7% LAGGING POWER FACTOR.

In the new meter the two elements which measure power and reactive component are mounted side by side, and a ball mechanism is mounted between them and mechanically connected as shown in Fig. 1, so that the ball is driven by the two discs d_1 and d_2 and in turn drives the wheel *w*. The condition corresponding to Fig. 1 obtains at 70.7 per cent. power factor, at which time the current in a polyphase circuit lags behind the voltage at an angle of 45 deg. Under these conditions the watt-hour meter and reactive meter speeds are exactly equal. It is evident, then, that the ball will rotate about a horizontal axis *xy*. If the radii *a* and *b* are drawn from the point of contact of the wheels d_1 and d_2 perpendicular to *xy*, the lengths *a* and *b* will be proportional to the watt-hour and reactive meter speed. The wheel *w* rotates at a speed proportional to the radius of the sphere, which is somewhat greater than *a* and *b*. It is evident that the two triangles *a*, *b*, *c* are equal, and it can be proved that they are equal

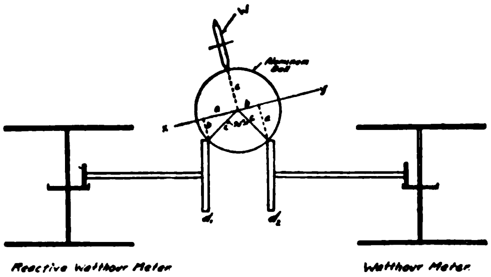


FIG. 2.—80% POWER FACTOR.

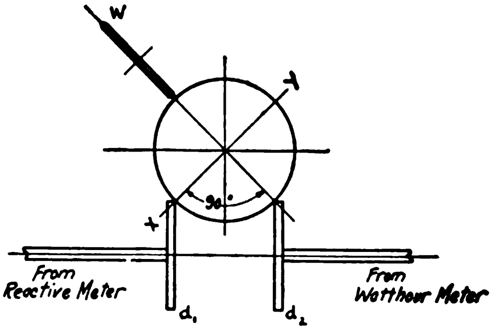


FIG. 3.—100% POWER FACTOR.

for all power factors. Since a, b, c is a right triangle, c the radius of the sphere is equal to $\sqrt{a^2+b^2}$, and therefore we have a true vector addition. The angular motion, then, of the wheel w is equal to the vector sum of the motions of the watt-hour and reactive meter elements and is equivalent to k.v.a. hours. The wheel w is mounted in a frame which moves about an axis perpendicular to the plane in which xy moves, and the axis of the frame would, if extended, pass through the centre of the ball. As the axis of rotation of the ball shifts, the position of w changes, so that it always rotates on a great circle with a speed proportional to the radius c. Through suitable gearing the wheel w is connected so as to drive the left-hand dials on the meter, which then register k.v.a. hours. This regulator is similar to registers used on watt-hour demand meters and is similar to the register on the right-hand side of the meter The pen is removed from the left-hand register and is replaced by a short arm which, through a connecting rod, drives the pen on the right-hand element. The right-hand register is connected to the watt-hour meter in the regular manner, but instead of operating a pen the demand mechanism carries a small adjustable stop which moves about the same centre as the pen driven from the k.v.a. element, but follows behind, slightly due to the fact that kw. is always equal to or less that k.v.a. At the end of the time interval when the clock resets the demand mechanism, the k.v.a. element is reset first and makes a well-defined mark at the end of the line on the paper. The pen falls back to the stop and makes a mark on the paper at this point. A fraction of a second later the kw. element also resets and the pointer returns to zero. The record on the chart then gives both kw. and k.v.a. demand, and by simple calculation the power factor for the time interval may be obtained by dividing the kw. by the k.v.a. demand. The indicated power factor at any time may be obtained by inspecting the position of the pointer carried by the frame on the ball mechanism.

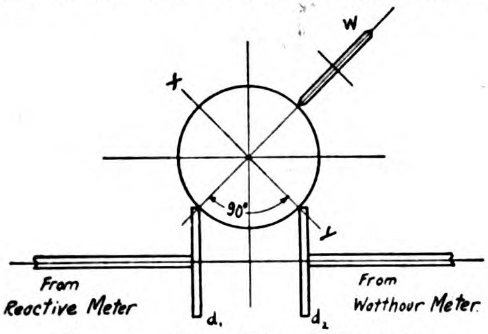


FIG. 4.—LOW POWER FACTOR.

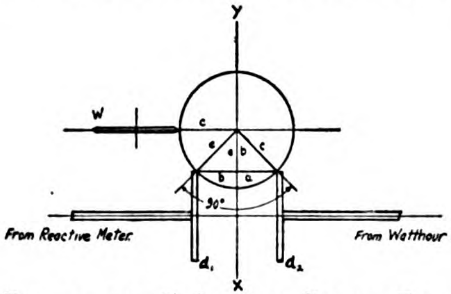


FIG. 5.—70.7% LEADING POWER FACTOR.

Referring further to the ball mechanism, the Figs. 2, 3, 4 and 5 show the different positions of the axis of rotation of the ball. In Fig. 2 the watt-hour meter speed is slightly greater relatively than Fig. 1, and the radius a is greater than the radius b. In this instance the power factor is approximately 80 per cent. In Fig. 3 the reactive meter is at rest and rotates about an axis passing through the point of contact of the disc d_1. In this position it is clear that there is a 1 to 1 ratio between the disc d_2 and the wheel w, with a resulting k.v.a. hour registration equivalent to kw. hours. As the

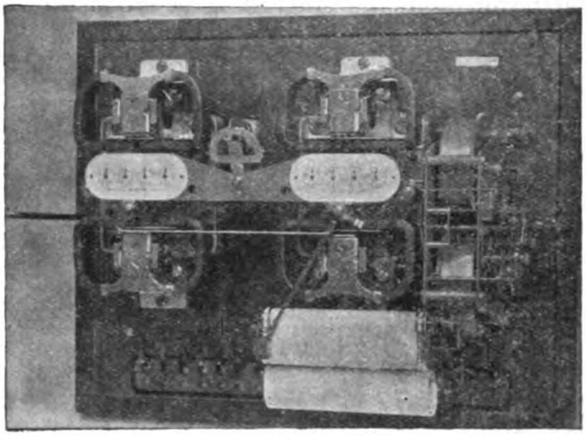


FIG. 6.—TYPE RI K.V.A. DEMAND METER.

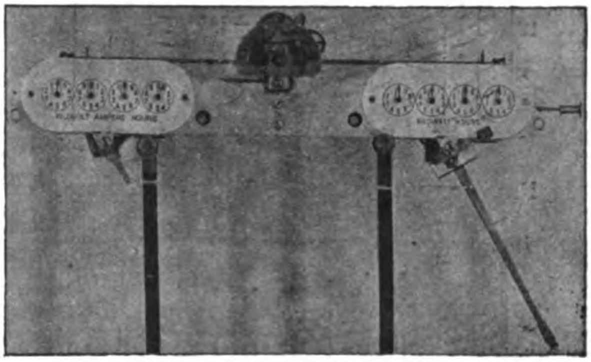


FIG. 7.—TYPE RI DEMAND METER, FRONT VIEW OF REGISTER.

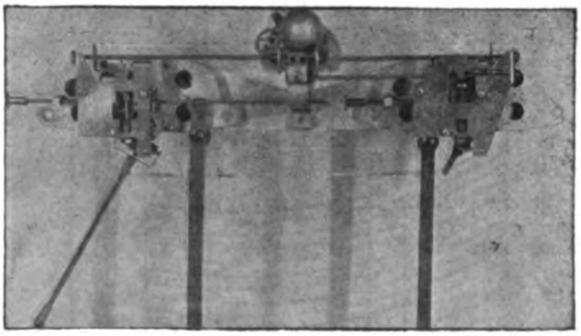


FIG. 8.—TYPE RI DEMAND METER, REAR VIEW OF REGISTER.

power factor becomes less than 100 per cent. the reactive meter starts to rotate, and, referring to Fig. 2 again, the rotation of $\frac{a}{c}$ is the cosine of the angle which measures the departure of the axis xy from the unity power factor position. In Fig. 4 the mechanism has reached the zero power factor position and the axis xy passes through the contact of the disc d_1, the watt-hour meter being at rest. In this position we have a 1 to 1 ratio between the reactive meter disc and the wheel w, making reactive watt-hours equivalent to k.v.a. hours. With a leading power factor the reactive element reverses, and Fig. 5 shows how with a 70.7 per cent. leading power factor the axis of rotation is vertical, but the wheel w still gives a correct integration of the vector sum of the motions which go to make up k.v.a. hours. This could be carried through the whole circle diagram of leading and lagging power factor and reverse power, but with reverse power the wheel w would have to be driven from the lower part of the ball, and this would cause mechanical interference.

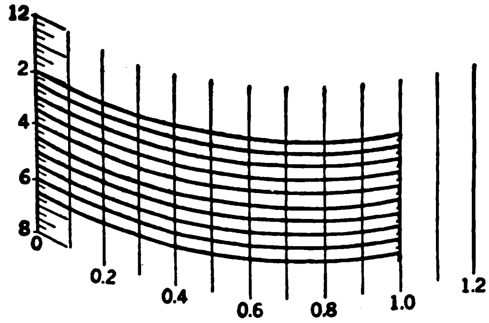


FIG. 9.—UNITY POWER FACTOR RECORD.

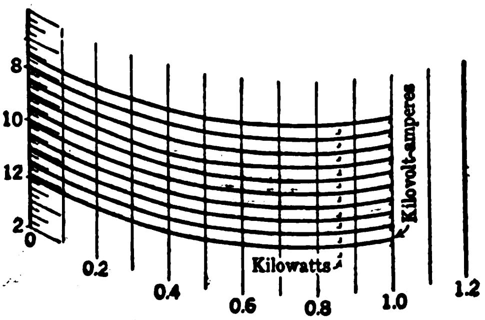


FIG. 10.—85% POWER FACTOR RECORD.

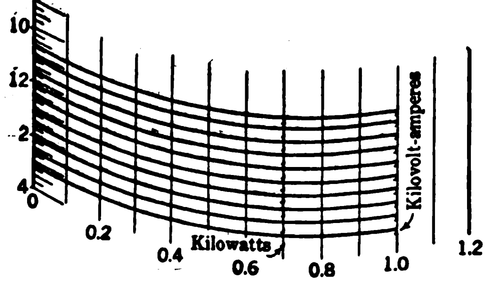


FIG. 11.—70% POWER FACTOR RECORD.

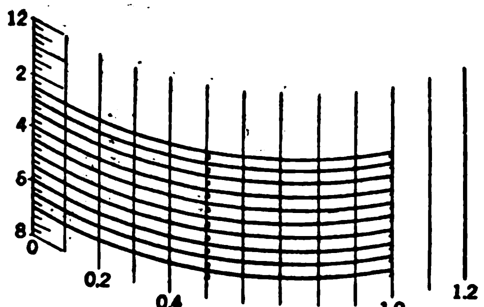


FIG. 12.—50% POWER FACTOR RECORD.

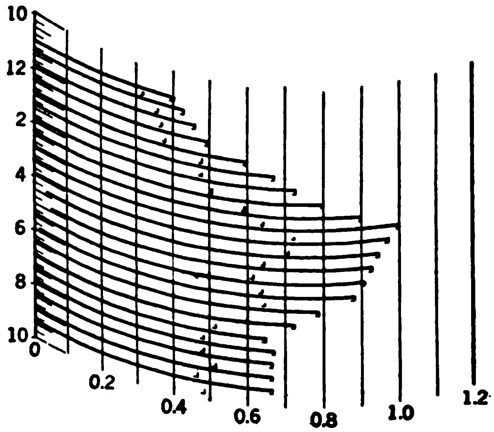


FIG. 13.—CONSTANT POWER FACTOR AND VARIABLE LOAD.

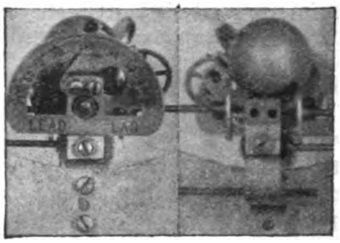


FIG. 14.—FRONT AND REAR VIEWS OF BALL MECHANISM.

There might be some question of whether there would be any slipping in a friction drive of this sort, but measurements show that the power required to operate the pen and k.v.a. counter-mechanism is only one-eighth of the power required to slip the wheel w on the ball. By checking the rotation of the watt-meter discs against the record on the chart, it is found that the proper registration is transmitted, which proves that the ball functions correctly.

The Engineers' Club.—During May the following meetings of interest to our readers will be held in the Club, viz.: 9th, Diesel Engine Users' Assocn. and Inst. of Aeronautical Engineers; 10th, Northampton Polytechnic Inst.; 13th, Inst. of Mining Electrical Engineers; 15th, Inst. of Mining and Metallurgy Council Club dinner; 21st, Inst. of Production Engineers; 26th, Inst. of Rubber Industry.

South Africa.—The April issue of the *South African Power Engineer* contains several well-illustrated articles of direct interest to electrical readers, including a long account of the new Pretoria power station and the central sub-station in the same city. Also, a detailed article on the successful gas-engine installation at Salisbury, Rhodesia, in which several novel features of the plant are indicated, and a page of photographs of engineering personalities, one of whom is the late Mr. Hubert Davies, who built up such a splendid connection in Johannesburg, and was for years the local representative of the London Inst. of Electrical Engineers.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of
CORRECT ARTIFICIAL LIGHTING

Advert of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application, Subscription : 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

Wembley.

The British Empire Exhibition is still proving a great attraction, in spite of the weather and other drawbacks. Work on the completion of hundreds of details left unfinished at the official opening is proceeding apace, and each day sees marked progress towards an ultimate completion. As I write, the King and Queen, accompanied by the Duke and Duchess of York, have just paid another of their informal visits and have made a tour of the Palace of Engineering. Their Majesties are keenly interested in the progress of the Exhibition, and were given demonstrations of the features of interest on several of the stands. In thus evincing a continued interest in what promises to be the centre of attraction throughout the coming summer they are setting an excellent example to the nation, which it is to be hoped will be generally followed by all who are able to spare the time and find the opportunity.

Absence of "juice" is still the outstanding grievance alike among exhibitors and the public, for it is impossible to give an effective display on any stand which depends in any way upon a supply of electricity which is not yet available. The incompleteness of the lighting is felt most keenly in the late evenings, when many stands are still shrouded in comparative gloom and offer no attraction to a late public whose only chance of viewing the exhibits is after business hours. Fortunately, daylight-saving and the ever-lengthening days are helping out, but the fact remains that the public like light, and plenty of it, and they are consequently indisposed to venture far into the larger Palaces of Engineering and Industry much after 8 p.m. It is difficult to arrive at the real cause of the trouble, but I am given to understand that cables, or the lack of them, are responsible for the delay. One sees cable-laying and service connections proceeding day by day, which in the natural order of things ought to have been carried out months ago, as soon as the sites of the various stands had been decided upon. I am told by one of the distribution engineers that in certain cases the exhibitors are entirely responsible, having delayed sending in their applications for service until the last minute, but one can scarcely conceive that a majority of exhibitors had been so short-sighted, and in any case one firm's sins should not be visited upon those who happen to be located in the same avenue and have fulfilled the conditions to the letter.

Already residence within the precincts of the Exhibition has its humours to compensate for the drawbacks of unreadiness. For example, one sees a certain staff featuring a leading vacuum cleaner busily engaged "dusting" their stand vigorously each morning before opening time. Then there is an apparent famine in hairdressing establishments within the Exhibition grounds; one hears rumours of a huge saloon, with upwards of fifty vacant chairs awaiting clients, but, so far as my own and other investigations have gone, up to the present the saloon is non-existent; at all events, I haven't been able to locate it; whilst several heavily bearded gentlemen, looking highly distressed at the prospect of a revival of the "Beaver" habit, have appealed to me in vain to direct them to the abode of the knights of the razors and scissors.

There is an important feature of the engineering and industrial exhibition at Wembley to which attention has already been directed by one of the associations responsible for the success of the electrical section, and that is the necessity for making them interesting to the general lay public. In addition to such exhibits as railway locomotives, naval guns, motor-cars, and such other familiar objects as are already fairly well understood by the lay public, the Palaces of Engineering and Industry simply teem with complex exhibits which the man-in-the-street has probably never seen before and does not even know their nature or application. Although beautiful examples of engineering skill, these exhibits lack interest to the visitor unless their functions are set out either in simple type, or preferably by some elementary and attractive form of demonstration showing the operation of the mechanism at a glance

Many exhibitors are already alive to the necessity for thus creating attraction and arousing interest in their displays, but others have merely staged their exhibits and labelled them, in many cases with technical descriptions which leave the average visitor still in the dark as to their real purpose. As a case in point, there is a really fine example of a large horizontal engine on a stand in one of the main avenues of the Palace of Engineering. Its sponsors refer to it as a "steam extraction engine," and when passing the exhibit with an electrical engineering friend last night, a technical man of considerable experience, he expressed ignorance of the term, and asked what the function of the plant was. This is an age of specialisation, and if an experienced engineer in one branch is ignorant of the nature of certain exhibits in his own section, how can the general public be expected to understand a tithe of what is offered to their gaze in this magnificent display?

It only bears out a recent criticism of mine in these columns, that the technical man is too apt to live in a little world and speak a limited language entirely his own, which is unintelligible to the man-in-the-street. More than half the exhibitors in the two largest palaces should get experienced laymen to write their descriptive notices for them; they would know better how to make the public understand the nature of the mechanism on view. Undoubtedly a simple working model, preferably illuminated, or arranged to control flashing lamps of some description, is the best means of appealing to the visitors. The makers of the Strowger Automatic Telephone equipment, intended for the London service, stage an excellent example of the type of working model which appeals to the public. In a well-lighted case they show two Strowger Automatic Telephones with accompanying exchange mechanism. During the day the dials of these two phones are continually manipulated by two pairs of well-modelled feminine hands. The switches respond to the movements, and the progress of an automatic call is clearly indicated. There is invariably a small crowd round this very practical demonstration.

The Exhibition Habit.

Wembley example seems to have inspired a similar spirit in other quarters, for there have been quite a number of electrical exhibitions up and down the country of late. The latest was that at Hanley, held last week, and staging heat, light, and power exhibits. Judging from the official guide which is before me, it must have been a highly representative show and very creditable to its organisers, the supply departments of the County Borough of Stoke-on-Trent. These provincial shows, following in the footsteps of the larger enterprise in the Metropolis, indicate the right spirit of enterprise, and their location serves to indicate where the business of electricity supply, at all events, is being tackled in the right spirit. Show the public what electricity, freely used, is capable of doing for it, and the demand will follow in good time, but hide the light under a bushel, cultivate the apathetic spirit, and display no interest in anything except a heavy power and tramway load, and there is no progress, nor can there ever be any in such districts.

Tunnel Lighting.

Apropos the recent regrettable fatalities arising out of the Cup Final train collision, I see that a correspondent, writing to the daily Press, advocates the independent illumination of tunnels, so that, in the event of such disasters, the survivors are not left to grope their way to safety in pitch darkness. There certainly should be some emergency lights in busy railway tunnels to provide against such contingencies, and the electricity supply to such a system of tunnel lighting must necessarily be derived from circuits independent of the traction supply, which is inevitably cut off in the event of a smash. Darkness adds both to the horrors and the difficulties of rescue, and a light or two which did not fail in such emergencies would go far to mitigate discomfort and suffering resulting from the actual disaster.

Purloining a Tramcar.

We occasionally come across reports of up-to-date thieves jumping into unattended motor-cars and driving off with them, but has anybody ever heard of the same being done to a tramcar? I can remember a steam-roller (which one might say belongs to the same heavy species) moving off while the driver was in a cookshop, though as it happened the inquisitive boy who had climbed on had no intention of having the machine "for keeps." No doubt he foresaw difficulties with his parents. And I can even remember a plot of my youth in which the gang decided to attack and commandeer a tramcar (whilst it was unattended) at the near-by terminus—the game of flattening our trouser-buttons on the tramlines and taking perilous rides behind trams having become tame. The tramcar was duly surrounded, but our bold chief had barely seized the control handle when the unexpected appearance of the driver and conductor, and some well-placed smacks from the latter, caused a sudden rout.

But here, as ever was, is a newspaper report of a grown-up chap, aged 32, and in full possession of his senses, boarding a Burnley tramcar and calmly driving off with it. He had carefully waited until there was no driver or conductor aboard, but, funnily enough, there were several passengers inside—who, it seems, didn't matter! After travelling some distance the miscreant pulled up. Apparently he had, after all, no intention of robbing the Corporation of one of their tramcars, else I suppose he might have gently but firmly requested the passengers to dismount—unless he wanted to hold them to ransom. However, it seems that the terrible fellow had been a tramcar driver, and, having a grievance against the Corporation Tramways Committee, took the opportunity of showing that he could still drive. The demonstration resulted in an appearance before the Bench, who "considered the offence a serious one and imposed a fine of 40s. or 21 days' imprisonment"—a sentence which strikes me as being a bit petty and, as regards the alternative, out of all proportion.

Glasgow a Health Resort!

They seem to be optimists with a vengeance up in Glasgow. A short time ago a complimentary dinner was given in the canteen of the Dalmarnock Power Station, and during the speech-making Bailie Kerr mentioned the remarkable progress made by their Electricity Department in its 31 years' existence. He went on to say that he was "one of the people who believed that so great strides would be made by the Electrical Department in air purification that Glasgow Green, rid of the present smoke clouds, would again become the fashionable promenade it was stated to have been in 1790." And later Dr. Dewar said that it had been suggested that by the general adoption of electricity, Glasgow might yet be transformed into a health resort. He would not live to see the day, but it was bound to come. It would not arrive, however, till the atmosphere was rid of the noxious, invisible gases which at present polluted it. Electricity would do this. Well, we can do with as much as you like of this kind of optimism. Let us hope that not only will electricity soon make this coal-smoke age a thing of the past, but the generation of power itself be free from all such refuse. If with this we get that very much needed cheapening of electricity to the domestic consumer, then indeed will the electrical era be upon us.

I mentioned that the dinner was given in the canteen of the power-station. I ought to add that the cooking was all-electric, though one might expect this. The electric kitchen serves a double purpose: lunches are prepared for people in the station itself and also sent in special containers to outside sub-stations, and useful propaganda and demonstrations are given. I am specially interested in the provision of lunches. It is a pity that the practice is not general. There is no reason why, for instance, so many employees "on shift" should have to put up with a pocket snack and a mug of tea. Of course, if a small electric oven and an electric kettle are available, and time can be spared, some better sort of alternative is possible. I recall a certain switchboard attendant who made a point of having a hot lunch; he always had something particularly dainty and of delightful aroma every day I happened to have a job in the switch-room. As I would have merely a meat sandwich or two, or perhaps not that, you can imagine my feelings round about 12 o'clock!

Meals "On the Job."

ELEKTRON.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 180.

Can any reader inform me how I can obtain the value of the inherent reactance of an alternating current generator? I have no particular make of machine in mind, but current limiting reactances interest me and I cannot get any technical details.—" H. B. HURRY."

QUESTION NO. 181.

I wish to make up a condenser for a home-made wireless set with mica and tin foil. Can any reader give me constructional details, *i.e.*, thickness of mica, quantity of tin foil, and precautions to be taken?—" E. J. MORTON."

(Replies to Questions Nos. 180 and 181 must be received not later than May 31, 1924.)

Removal.—The Foster Engineering Co., Ltd., have transferred their Scotch branch office from 67, Waterloo Street, to 27, Blythswood Square, Glasgow (Tele. No. Douglas 324), under the management of Mr. W. Yuille, late of Messrs. John T. Cartwright.

The Kelvin Centenary.—Prof. Elihu Thomson, of Massachusetts, U.S.A., has been awarded, by the Presidents of the eight British Engineering Institutions constituting the Award Committee, the triennial Kelvin Gold Medal, for 1923, and formal presentation of the medal to him will take place during the Kelvin Centenary celebration in July.

TELEPHONY—FINAL GRADE.*

Being solutions to questions set in the Examination in the Final Grade of Telephony, held by the City and Guilds in May, 1923:

Q.—If E be the value of the alternating electromotive force impressed at the sending end of an indefinitely long underground telephone line, give a formula indicating the value of the current at a point l miles from that end, and explain exactly what the expression means.

If the line were not indefinitely long, would the formula be correct, and, if not correct, why?

A.—Consider an underground telephone line of resistance R ohms, inductance L henrys, capacity K farads, and leakance S mhos all per loop mile of the line.

Then the value of the current I at a point l miles from the sending end of the line is given by

$$I = \frac{Ee^{-\alpha l}(\text{Cos } \beta l - i \text{ sin } \beta l)}{Z_0} \ldots\ldots\ldots\ldots\ldots\ (1)$$

where α and β are constants having the values,

$$\alpha = \left\{\tfrac{1}{2}\sqrt{(R^2 + p^2L^2)(S^2 + p^2K^2)} + (SR - p^2LK)\right\}^{\frac{1}{2}}$$

$$\beta = \left\{\tfrac{1}{2}\sqrt{(R^2 + p^2L^2)(S^2 + p^2K^2)} - (SR - p^2LK)\right\}^{\frac{1}{2}}$$

p is 2π times the frequency of the applied e.m.f.

$Z_0 = \sqrt{\dfrac{R + ipL}{S + ipK}}$ is called the *Sending end impedance* of the line.

$i = \sqrt{-1}$

Equation (1) tells us that the current at any point of the line is the joint effect of two factors; one, the exponential factor $e^{-\alpha l}$, called the *attenuation factor*, that diminishes in geometrical progression as the distance l increases in arithmetical progression; α itself is termed the *attenuation constant*. The other factor, viz., $(\cos \beta l - i \sin \beta l)$ called the *Phase factor*, repeats itself at points apart equal to $\dfrac{2\pi}{\beta}$ which is the wave-length of the disturbance. On account of this β is termed the wave-length constant.

It is clear that as l increases the current rises and falls in a simple harmonic manner, but the maximum values gradually become less.

It will be noticed that the expression for the current I is a complex quantity, and may be reduced to the form

$$I = Ee^{-\alpha l}(A^2 + B^2)^{\frac{1}{2}}\,[\text{Cos } (\beta l - \theta) - i \text{ sin } (\beta l - \theta)] \ldots (2)$$

where $\sqrt{A^2 + B^2} = \left[\dfrac{S^2 + p^2K^2}{R^2 + p^2L^2}\right]^{\frac{1}{2}}$

and $\theta = \tan^{-1}\left\{\dfrac{\sqrt{(S^2 + p^2K^2)(R^2 + p^2L^2)} - (RS + p^2LK)}{\sqrt{(S^2 + p^2K^2)(R^2 + p^2L^2)} + (RS + p^2LK)}\right\}^{\frac{1}{2}}$

If the alternating e.m.f. E is represented by E_m sin pt where E_m is its maximum value, then on substituting $E_m e^{ipt}$ for E in equation (2) we get

$$I = E_m e^{-\alpha l}(A^2 + B^2)^{\frac{1}{2}}\,[\text{Cos } (pt - \beta l + \theta) + i \text{ sin } (pt - \beta l + \theta)]$$

and retaining only the imaginary part of this expression, since the impressed e.m.f. is represented as $E = E_m$ sin pt only, we finally get for the instantaneous current I_e at a distance l from the sending end at time t

$$I_e = E_m (A^2 + B^2)^{\frac{1}{2}}\, l^{-\alpha l} \text{ sin } (pt - \beta l + \theta).$$

---

* Books recommended are *Questions and Solutions in Telegraphy and Telephony, Final Grade,* by Few (Rentell, 2s. 2d. post free), and *Practical Telephone Handbook,* by Poole (Rentell, 15s. 6d. post free).

The above expression is not correct for lines of finite length, because of the considerable modifications introduced by the reflection of the current wave at the receiving and sending ends of the line; the solution for a line of finite length will depend upon whether the end of the line is disconnected or short circuited at the far end, and is further modified by the presence of impedances at the receiving and sending ends.

(To be continued.)

DEVELOPMENT OF THE BELLINI-TOSI SYSTEM OF DIRECTION FINDING IN THE BRITISH MERCANTILE MARINE.*

By COM. J. A. SLEE, C.B.E., R.N. (Ret.), Member.

(Continued from page 226.)

It has been found in practice that if the lack of symmetry is such that the zero is lost at 0 deg., 90 deg., 270 deg. or 360 deg. without destroying the perceptible maxima at the 45 deg. positions, bearings will still be quite accurate when the mid-point is used unearthed, except for its static leak.

To sum up:—

(*a*) Perfect symmetry is indicated by signals of equal strength at the four 45 deg. positions, with clear zeros between.

(*b*) Very slight lack of symmetry is indicated by signals at one pair of 45 deg. positions being stronger than at the other pair, clear zeros still existing.

(*c*) Slight lack of symmetry is indicated by signals as at (*a*), but with the zero between the loudest positions obscured.

Bearings are still practicable under any of the above, provided that the mid-point is not earthed.

As the lack of symmetry becomes greater, the maxima at the 45 deg. positions disappear, loudest signals appearing with the pointer at one of the 90 deg. positions. In all cases signals are loudest when the search coil is under the field coil of the defective loop.

These symmetry tests are very critical and easy to apply. They disclose any doubtful contact or poor insulation, as well as uneven distribution of inductance or capacity. Unhappily, they do nothing towards the detection of inductive lack of symmetry of the magnitude likely to be met with at sea, which can only be tested for the observation of external bearings with very strong signals.

(5) CALIBRATION.

Calibration is perfectly simple provided that the ship is well clear of cranes, sheds, etc. A station having a bow or quarter bearing should be selected, and if the observed bearing is too near the fore-and-aft line the fore-and-aft loop must be reduced—or the impedance increased—until the bearing is correct. If all other errors have been eliminated, the correction of a single bow or quarter bearing implies accuracy all round, but it is as well to take some check observations.

Under practical conditions the fore-and-aft loop is usually about four-fifths the area of the thwartship loop, and a reduction of one foot on each side of the bottom of the fore-and-aft loop will produce a correction of about 1 deg. in a bow or quarter bearing. Such figures are empirical and very rough, but they give some idea of the state of affairs.

Calibration can be carried out only on or very near the bow and quarter bearings.

The final external test is for inductive lack of symmetry, which should be carried out with very strong signals very nearly right ahead and on the beam. In the absence of errors due to this cause, the direction-finder can be trusted, but it must be remembered that the loops, and especially the lower parts, are almost as sensitive as a magnetic compass to the influence of external objects. A pile of Carless rafts placed temporarily under one limb of a loop, and a wet signal-halyard passing near one limb, have been recorded as producing errors of 5 deg., and a wire whistle-lanyard passing near one side of the fore-and-aft loop has been identified as the cause of an error of 14 deg.

It is well established that under conditions in which all the above can be eliminated, the errors of a Bellini-Tosi direction-finder need never exceed 1 deg.

When using a direction-finder in a ship at sea it is imperative that the main aerial shall be completely disconnected from earth. Otherwise, large errors of a quadrantal nature will be introduced. If the main aerial passes close to either of the loops it is not sufficient to disconnect between the transmitting apparatus and the earth connections; the main aerial must be disconnected immediately it enters the wireless room. The reason for this is that there is sufficient stray capacity in the transmitter to allow so much current to flow in the main aerial that the resultant "loop" current is affected.

Calibration cannot be completed if the ship is lying near to cranes or dock sheds, although an approximate result can be obtained. The work must be completed with the ship at sea.

The symmetry tester will reveal the impossibility of calibration. A pair of loops which give excellent results, and which test perfectly for symmetry when the ship is at sea, will appear to be hopelessly at fault if the ship is near to cranes, etc. The symptoms are different from those of slightly unsymmetrical loops—the usual effect being that the positions of all zero signals are slewed round bodily about 20 deg.

(6) APPLICATION.

Having established a direction-finder in correct adjustment, the problems of making full use of it as an aid to navigation can be tackled. The outstanding point is that a direction-finder takes relative great-circle bearings, that is to say, great-circle bearings relative to the keel line of the ship. These must be converted into true Mercatorial bearings before they are of any use for navigation. If the ship is yawing, the observation of the direction of the ship's head at the moment when the bearing was taken may be rather vague. The usual practice is for the operator to ring a bell when the direction-finder bearing is taken and for the direction of the ship's head by compass to be noted when the bell rings; and considerable combined practice between bridge and wireless room is necessary before the gap between a good direction-finder bearing and a serviceable true bearing can be filled up.

Taking all the above into account, for the purpose of making up tables, bearings are reckoned as being "correct" if they do not err by more than 2 deg.

---

* Paper read before the I.E.E.

from that worked back from a recent position by observation, 1 deg. being allowed for residual direction-finder errors and operator's observation, and 1 deg. for errors developing in the operation of translating the direction-finder bearing into a true bearing.

Direction-finder bearings at distances of over fifty miles are not, as a rule, of any great service, and at distances over a hundred miles they are only a rough guide. This is not because of the liability to error being increased, but because the fix so obtained is so very rough in comparison with older-established methods of navigation.

(To be continued.)

THE ENGLISH ELECTRIC CO., LTD

The annual general meeting of the shareholders of this company, which is one of the principal representatives of the electrical industry in the country, was held on the 30th ult. at the Connaught Rooms, and notwithstanding the many difficulties and obstructions which have affected the engineering trades generally, not to speak of the excessive burdens of taxation and foreign competition, the accounts given could not be considered other than satisfactory for the past year; while work in hand and contracts held may be considered as giving considerable promise for the future. While the dividend on the ordinary shares is but 5 per cent., yet under existing conditions of industry if all overhead charges can be covered and reasonable necessary reserves provided for, the provision even of 5 per cent. from legitimate profits reflects not only credit on the conduct and management of the directorate, but also on the efficiency and collaboration of the staff and workers. The Chairman of the company, in his address, referred to the excellent relations existing between all parties connected with their works, and paid a tribute to the splendid loyalty of the whole staff, by which the real measure of achievement they were able to record for the year under review had been made possible. It may be known to many of our readers that this company has arisen out of the combination of several old British firms—English and Scotch—who were founders and pioneers in their day of the introduction and development of many new features in electrical engineering, and the capabilities of the present firm are well illustrated in their exhibits at the Wembley Exhibition, while the contracts for work in hand comprise some thousands of horse-power, both in generators and motors, and the accompanying control gear connected with the electrification of railways in this country and in hydro-electric and other schemes being carried out both within the Dominions and in foreign lands.

Situations Vacant.—Readers who are interested in this important subject—and we fear there are many—should read the advertisement "Engineering" in the small prepaids page. It may be of some good to them.

Sweden.—We have been favoured with a copy of the March issue of the *Swedish Economic Review*, in which details are given of the trade conditions during the first quarter of the year. Apparently production and employment have remained at a fairly satisfactory level, and as the imports of raw materials have lately increased, this may be taken as a sign that confidence in the future is returning in manufacturing circles in Sweden.

ELECTRIC DRIVING OF A MODERN FACTORY.*

BY F. W. SMITH, N.A.S.E.

(Continued from page 235.)

One is often faced with the problem of finding the power required to drive a machine, as more often than not the makers have carefully refrained from giving this very necessary information; and, rightly or wrongly, the prospective customer considers that as an engineer you should know every machine on the market, and the exact power to drive it. The form of enquiry nine times out of ten is something like this:

What power do I require to drive my "Never Fail" machine? Now you will admit that this is a pretty tough question, and obviously the only thing to do is to trot along and see the machine, one can then estimate the power fairly accurately by taking the width of the pulley face and the diameter, also the speed; if the diameter of the pulley is multiplied by π and the speed, divide this by 12 will give the speed in feet per minute.

$$\frac{\text{Diam.} \times \pi \times \text{speed}}{12} = \text{ft. per min.}$$

$\pi = 3.1416$

By taking 2 h.p. for every inch of pulley face when running at 1,000 feet per minute, will give the power required to drive the machine approximately.

A light double leather belt will transmit 2 h.p. at 1,000 feet per minute.

A heavy double leather belt will transmit 2¾ h.p. at 1,000 feet per minute.

Speed calculations:

$$\frac{\text{M/c shaft speed} \times \text{by diam. of pulley}}{\text{Motor speed.}} = \begin{array}{l}\text{Motor}\\\text{pulley}\\\text{required.}\end{array}$$

$$\frac{\text{Motor speed} \times \text{by diam. of pulley}}{\text{Machine speed.}} = \begin{array}{l}\text{Machine}\\\text{pulley}\\\text{required.}\end{array}$$

The following will indicate the power required if there are no pulleys on the machine.

Diam. of shaft inches.	H.P. safely transmitted R.P.M.						
	100	150	200	250	300	350	400
1½	3.4	5	6.7	8.4	10.1	11.8	13.4
1⅝	4.3	6.5	8.4	10.8	12.9	15.9	17.5
1¾	5.3	8	10.7	13.4	16	18.1	21.4
2	8	12	16	20	24	28	32
2¼	11.4	17	22.8	28.5	34.1	39.8	45.5
2½	15.6	23.4	31.1	39	46.8	54.6	62.3
2¾	20.8	31.2	41.5	51.9	62.2	72.6	83
3	27	40.5	54	67.5	81	94.5	108
3½	42.9	64.3	85.8	107	129	150	171

SPEED REGULATION.

This is one of the most important things that has to be considered when driving printing machines, as the wrong method of speed control can very easily mar what would otherwise be a good job.

---

* Lecture delivered before the N.A.S.E.

There are four ways in which the speed of a D.C. motor can be varied:—

(1) Inserting resistance in the armature circuit.
(2) Varying the supply voltage.
(3) Inserting resistance in the shunt field.
(4) Double winding the armature.

Regulation by armature resistance: This is a wasteful method of control, and can only be recommended when the first cost is the ruling factor. The energy consumed is practically the same at all speeds, and if the load varies the speed will also vary.

(To be continued.)

AUTOMATIC TELEPHONES.

Mr. William Aitken's third volume on "Automatic Telephones," which will be published immediately, completes this comprehensive work. Similar in style and treatment to the first two, this volume covers large multi-office automatic systems, semi-automatic workings, and miscellaneous systems, and concludes with a series of sections devoted to lay-out and wiring, power-plant and traffic problems.

The introduction of the Strowger system by the British Post Office for London and other large areas of this country, says Mr. Aitken, practically means that step-by-step switch systems will become standard practice here. This system is widely used in practically every country of the world, but systems with power-driven mechanism are also being widely adopted elsewhere. On the Continent of Europe the Rotary system is being introduced into many of the large cities; in the United States the Panel system has been installed in a number of towns, and that number is increasing. A fundamental difference between the two opposing systems lies in the driving means. While the Strowger system is driven by step-by-step mechanism, in the Western Electric Company's Panel and Rotary systems, and also in the new Ericsson system, the switches are driven by bringing their mechanism into engagement with continuously running shafting. These different systems are minutely described.

A special feature of the present volume is the inclusion of twenty-five folding plates, illustrating in exceptional detail on a large scale the systems actually introduced into New York and other large towns in the United States.

The volume is published by Ernest Benn, Ltd., at 55s. net, and may be obtained from the office of this paper.

"A NEW SELF-EXCITED SYNCHRONOUS INDUCTION MOTOR."

By Val. A. Fynn.

This is the title of a well illustrated and decidedly interesting paper which was presented at the Spring Convention of the American Institute of Electrical Engineers, which was held at Birmingham, Alabama, U.S.A., from April 7 to 10 inclusive. In it two early forms of the synchronous induction motor are described and their performance analysed with special reference to synchronising torque. A new self-excited form of this type of motor devised by the author is there described, its mode of operation and characteristics are elucidated and the principles governing its design explained with the help of vector diagrams. An analysis of the synchronising torque shows that whereas prior machines all exhibit an alternating synchronising torque of either slip, or double the slip frequency, the synchronising torque in the new motor is substantially unidirectional and pulsating. The machine is particularly well suited for smaller units, and operates with unity or leading power factor throughout its normal load range without taking an excessive current at any load or requiring any adjustment other than that automatically provided by its inherent regulating capacity. Mr. Fynn will probably be remembered by many of the older generation of our readers as a Bradford electrical engineer who went out to the United States many years ago.

Various Items.

Situation Vacant.—A sales engineer is required by manufacturers of D.C. and A.C. meters. For full particulars see prepaid advertisement.

Quotations Wanted.—The Public Works Dept., Wellington, N.Z., invite tenders for 12 sub-station transformers for Waikato.——The P.M.G.'s Dept., Melbourne, Australia, invite tenders for telegraph equipment. Specifications, etc., at the D.O.T. (Room 52), 35, Old Queen Street, S.W.1.

The "English Electric Journal."—The April issue of the *English Electric Journal* contains an interesting *résumé* of the work of the English Electric Co. during 1923 as well as illustrated articles on different machines and plant which have been carried out by the company during the recent months. It should, therefore, prove most readable to all who are fortunate enough to receive it.

Faraday House O.S A.—This Old Students' Association held its annual smoking concert at the Hotel Cecil on Friday last, the 2nd inst., there being a very good attendance of past and present Faradians. The chair was occupied by the President of the Association, Mr. R. N. Vyvyan, M.I.E.E., and an excellent musical programme was provided.

The King and Queen at Wembley.—During their Majesties' visit to the British Empire Exhibition on Friday, the King inspected the various exhibits in the Palace of Engineering, and started up the automatic sub-station on the British Thomson Houston Company's stand. Their Majesties were able to see the illumination of this stand in its fullest splendour, and expressed themselves delighted with the effect.

Motor Ships.—The May issue of the *Motor Ship* contains several items of interest to electrical engineers, including a description of the generating sets and batteries as well as of the electrical auxiliaries which have been fixed on the motor yacht *Princess*. There are also some splendid illustrations dealing with other motor-driven vessels, for which more orders were placed last month than have been recorded in any month during the past four years. A sign of a revival, at any rate, in the motor ship industry.

Swiss Industries Fair.—The electrical industry will be substantially represented at the eighth Swiss Industries Fair, to be held at Bale from May 17 to 27. The Fair, which originated in the fifteenth century, constitutes an exhaustive exhibition of Swiss manufactures. It will be housed, on the coming occasion, in commodious new quarters, the former Fair buildings having been destroyed by fire. Dr. Meile, the managing director, anticipates a record attendance. Bale's newly built harbour on the Rhine has of late lent additional importance to the city as a commercial and industrial centre. Last year traders from twenty-one different countries attended the Fair, where private offices, shorthand-typists and interpreters are available for the conduct of business.

You have not learned much until you have lost much.

ARMATURE REPAIRS
MARRYAT & PLACE
28, HATTON GARDEN,
LONDON, E.C.1.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

MAY 16, 1924.

CONTENTS.

PAGE
The Influence of Wave Distortion on Power Factor .. 251
Electric Lighting in Churches 252
Educational Broadcasting 253
Telephony—Final Grade (Solutions) 253
The Advantage of Air Heating 254
Current Topics 257
" Electricity Supply in War-Time, as Affected by the Improvements in Heavy-Oil Engines" 259
Electric Driving of a Modern Factory 260
Questions and Answers by Practical Men 261
Development of the Bellini-Tosi System of Direction Finding in the British Mercantile Marine 261
Various Items 262

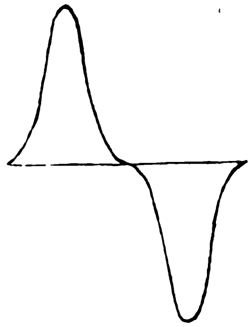
THE INFLUENCE OF WAVE DISTORTION ON POWER FACTOR.

By G. W. STUBBINGS, B.Sc.

Elementary notions of power factor are usually based upon the notion of a phase angle, the power-factor being taken as the cosine of the phase angle between successive zero values of the current and voltage in the circuit considered. The method of regarding alternating electrical quantities as vectors is very convenient, but it is legitimate only when the variation of such quantities with respect to time is sinusoidal. With non-sinusoidal variation, the vector treatment is no longer accurate. In a circuit fed from a sinusoidal voltage, but containing a current with a distorted wave-shape, the power factor is no longer equal to the cosine of the phase angle between successive zero values of current and pressure.

A distorted current wave can be resolved into a sinusoidal wave of normal frequency and a number of harmonics of varying frequencies and phases. Of the various components only the fundamental can combine with a sinusoidal voltage to produce power. Each harmonic will, however, contribute to the effective or R.M.S. value of the current.

FIG. 1.



A distorted wave of elementary nature is shown in Fig. 1. This consists of a reversed third harmonic superimposed on a fundamental, the amplitude of the harmonic being one-third that of the fundamental. The equation to the wave is

$$I = I_{max} \sin pt + \frac{I_{max}}{3} \sin 3\,pt$$

The R.M.S. value of this current is

$$\frac{I_{max}}{\sqrt{2}} \sqrt{1 + \frac{1}{3^2}} = \frac{1.05}{\sqrt{2}} I_{max} = 1.05i$$

i being the virtual value of the fundamental.

The power in the circuit carrying this current is $iv \cos \phi$, where ϕ is the phase angle between the fundamental of the current wave and the voltage, this voltage being assumed to be sinusoidal, since the power of the harmonic being the average value of

$$I_{max} V_{max} \sin pt \sin (3\,pt - \phi)$$

must necessarily be zero.

The power factor of a circuit is defined as the ratio. Watts/volt amperes, and the power factor in the case in question is

$$\frac{iv \cos\phi}{1.05\, iv} = 0.95 \cos\phi$$

The power component of the current is $i \cos\phi$. The wattless component is the resultant of the wattless component of the fundamental and the harmonic. The R.M.S. value of the wattless current is accordingly $i\sqrt{\sin^2\phi + (0.11)^2}$. It is, therefore, seen that the total wattless current in the circuit is given by $i\sqrt{1-p^2}$, where p is the power factor.

The maximum value of the power factor occurs when $\cos\phi$ is unity, that is, when the fundamental in the current wave is in phase with the voltage. This maximum value is 0·95.

It is easy to see that, generally, if the amplitude of the harmonics in the current wave are equal to m_1, m_2, m_3, etc., times the amplitude of the fundamental, then the power factor is

$$\frac{\cos\phi}{\sqrt{1 + m_1^2 + m_2^2 + \text{etc.}}}$$

From these results it appears that unity power factor is only possible in a circuit in which the pressure and current waves are identical in form. If this condition does not obtain it is no longer legitimate to regard the power factor as the cosine of a phase angle.

The measurement of power factor could, in actual practice, be carried out in three ways: (*a*) by direct observation of amperes, volts and watts; (*b*) by means of a power factor indicator; and (*c*) by means of integrating instruments of the wattmeter type. The first method, although direct, is not a convenient one for general use, and the second and third of these methods are usually resorted to. Since these latter methods are necessarily indirect, it is desirable to enquire into the accuracy obtainable when non-sinusoidal waves are being dealt with.

A single-phase power-factor meter may be considered as a system of coils giving a rotating field derived from the voltage of the circuit and a coil carrying the current, the current and pressure components of the instrument being capable of relative rotation. The voltage field will have an angular position with respect to the axis of the series coil equal to $(pt + \theta)$, θ being the angle between the axes of the series coil and the coil of the moving system carrying the current in phase with the pressure. The torque on the moving system due to the series flux F will be

$$k\, v\, F \sin(pt+\theta)$$

The pulsating field due to the series coil, in the case of the wave previously considered, will be

$$k_1 i \left\{\sin(pt-\phi)-\tfrac{1}{3}\sin(3\,pt-\phi)\right\}$$

The instantaneous torque in the moving system is, therefore,

$$k_2 iv \left\{\sin(pt+\theta)\ \sin(pt-\phi)-\tfrac{1}{3}\sin(pt+\theta)\ \sin(3\,pt-\phi)\right\}$$

The average value of the second of these terms is evidently zero, since different frequencies are being considered, and the average value of the first term is zero when $\theta = -\phi$. The angle θ will therefore equal the phase angle of the fundamental with respect to the voltage, and the reading of the instrument will indicate $\cos\phi$. When the zero values of the current in Fig. 1 were simultaneous with those of the voltage the power-factor meter would give a power factor of unity, the correct value being 0·95.

The measurement of power factor by means of a watt-hour meter in conjunction with a meter integrating either actual or wattless kilo-volt amperes will at once be seen to give a value of the power factor equal to the phase angle of the fundamental, since the harmonics in the current wave are not competent to combine with the voltage to produce any torque in the kVA instruments.

It would appear that the measurement of power factors, either by a power-factor meter, or by integrating instruments of the wattmeter type, gives accurate results only when the current and voltage waves are of similar shape, and that considerable errors can arise where distorted waves are concerned. It would be a simple matter to remove this difficulty by adopting a new definition of power factor as being the ratio of the actual watts to the maximum watt obtainable by shifting the phase of the voltage. This definition is usually tacitly assumed when unbalanced 3-phase circuits are concerned, apart from the question of non-sinusoidal wave forms. The definition of power factor as watts/volt amperes is, however, the one which gives what is virtually a measure of the efficiency of the current as a medium for conveying power. Any other definition is artificial from a commercial point of view, in that it affords no criterion for assessing the actual kVA of plant required to supply each kW of a consumer's maximum demand.

The monthly price list for May, 1924, has just been issued by the **Siemens and English Electric Lamp Co., Ltd.**, of 39, Upper Thames Street, London, E.C.4, and should be obtained by all contractors and trade dealers in electrical supplies generally.

An Interesting Invention.—We notice that the "Lofts Safety Electric Irons, Ltd.," has been registered in Australia, and one of the items which the company will control is a new alloy believed to be the only alloy available in the world which can be used to control the temperature of dry-heat electrical appliances.

Neatly printed circulars dealing with the Bastian Electric Storage Geyser have just been issued by **Messrs. Bastian and Allen**, of 58, Haymarket, London, S.W.1, and can be recommended to the notice of our readers. Several of these geysers have been installed at the British Empire Exhibition, and ten of them have just been shipped for use at the new Government buildings at Delhi, a fairly sound proof of their trade value for the special purpose for which they have been designed.

ELECTRIC LIGHTING IN CHURCHES.

On Friday, 2nd inst., Mr. F. H. Taylor, M.I.E.S., A.M.I.E.E., A.M.I.Mech.E., delivered a lecturette on "Electric Lighting in Churches," before the members of the Junior Inst. of Engineers, and in the course of his remarks said that a good scheme of lighting in a church must in the first place preserve the religious atmosphere, and also show harmony with the architectural surroundings, and not detract from the beauty of the decorations. It had to be remembered, in considering the method of installation, that most churches could afford to pay the cost only once, and, therefore, it was wise to use a system which was sure to have a long life. The best wiring system was undoubtedly screwed steel conduit, giving good electrical efficiency and freedom from fire risk. The time and labour expended in erecting and taking down scaffolding was an important item in the first cost, and also, of course, in any repair work found necessary afterwards, which emphasised the need for a reliable system.

Although the switching of transepts, side chapels and vestries was local, the switching of the nave, aisles, choir and chancel had to be from the west entrance. It was here, also, that main switch and fuse boards were usually placed. To obtain economy in working, and to avoid any large extinction of light, it was necessary for the nave to have its lighting fed from several circuits. Alternate lighting units were best switched together, and preferably, where each lighting unit consisted of four to five lamps, it should be possible to light up each fitting by two or more stages.

For the general lighting, pendant fittings of the corona pattern suspended from the roof gave best results, and at the same time offered an opportunity for artistic design. Concealed lighting at or above the capitals of the pillars sometimes allowed a fuller appreciation of the architecture of the church, and the source of light was quite out of the line of vision of the congregations. The extra distance away of the lighting units, however, meant an increase in the number or size of lamps required. A system of short lighting brackets attached by bands to the top of pillars had very little to commend it, save its cheapness, if that were commendation at all.

The chancel lighting should be the subject of special treatment, and, instead of the usual standard lamps fixed to the floor, lighting units concealed in the window recesses provided good illumination on the altar. Unless, however, the adjacent lighting units in the choir provided a certain amount of distributed light on the chancel walls and floor, a rather theatrical effect was apt to be produced, which was naturally undesirable. This could easily be avoided.

At the time of installing electric light in a church it was often convenient to arrange also for push button switches to operate lamps as signals—for instance from the west door to the organ, or from the choir vestry to the organ. A similar arrangement could be used to give time signals from the organ to the choir to aid the organist, who usually had to fulfil the duties of choirmaster. The lamps used were, of course, out of sight of the congregation, and suitable push buttons were now obtainable which would stand hard wear, and which were entirely noiseless in action.

The saving in cost of lighting by electricity instead of gas naturally varied with the prices of supply in the district, but in many cases this saving would probably be found to be enough to pay for the installation in a few years' time.

EDUCATIONAL BROADCASTING.

In connection with the special transmissions arranged by the B.B.C. for the purpose of exploring the possibilities of broadcasting for educational purposes, it is interesting to note that two very successful demonstrations have been carried out at the Wheatley Street Schools, Coventry. The first occasion was on April 4, when a lecture on music, by Sir Henry Walford Davies, was transmitted from the London station. The second transmission took place on April 11, when a lecture on the migration of birds, by Mr E. K. Robinson, was broadcast.

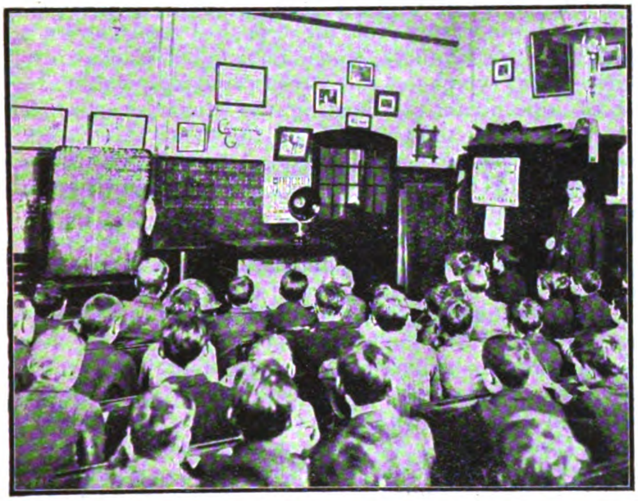


FIG. 1.—BROADCASTING A LECTURE AT THE WHEATLEY STREET SCHOOL, COVENTRY, WITH A B.T.-H. LOUD-SPEAKER AND A RADIOLA II. RECEIVER.

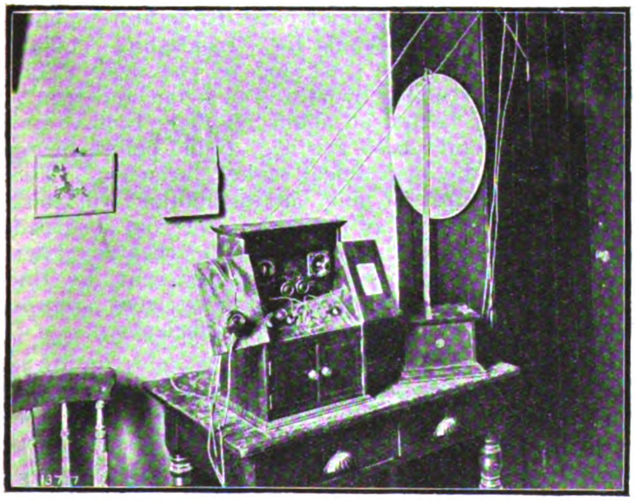


FIG. 2.—THIS PICTURE SHOWS THE RADIOLA II. (TWO-VALVE) RECEIVER AND A B.T.-H. TWO-VALVE POWER AMPLIFIER, INSTALLED IN THE HEADMASTER'S PRIVATE ROOM AT THE WHEATLEY STREET SCHOOL, COVENTRY.

The receiving apparatus used on both occasions was a standard Radiola II. (Two-Valve) Receiver, with a B.T.-H. Two-Valve Power Amplifier. On April 4 a single B.T.-H. Form C2 Loud-speaker was installed in one of the class-rooms, and the lecture was heard quite clearly and distinctly by a double class of 70 boys. On the second occasion three B.T.-H. Form C2 Loud-speakers, connected in parallel, were installed in three separate class-rooms, and the lecture was given simultaneously to three double classes, totalling approximately 210 boys.

In every respect the demonstrations were thoroughly successful, and the representatives of the local education authority who were present at the second lecture expressed their complete satisfaction with the results obtained. It should be noted that the apparatus used was of the ordinary standard types, and no special accessories of any kind were employed.

The two demonstrations referred to were carried out by the British Thomson-Houston Company, Ltd., who manufactured and supplied the apparatus.

TELEPHONY—FINAL GRADE.*

Being solutions to questions set in the Examination in the Final Grade of Telephony, held by the City and Guilds in May, 1923.

(*Continued from page* 248.)

Q.—A telephone receiver and a condenser are placed in series. The impedance of the receiver is 170 ohms and its phase angle is 45 degrees. The capacity of the condenser is 2 micro-farads. If an alternating e.m.f. of 1 volt be applied to the combination, what will be the maximum value of the current, and what will be the maximum value of the potential difference (*a*) across the receiver, (*b*) across the condenser? The frequency multipled by 2π is 5,000.

A.—If L is the inductance of the receiver and R its resistance, then its impedance is

$$(R^2 + L^2p^2)^{\frac{1}{2}} \underline{|\theta}$$

where θ is the phase angle $= \tan^{-1} \dfrac{Lp}{R}$

and $p = 2\pi \times$ frequency $= 5{,}000$.

Accordingly $(R^2 + L^2p^2)^{\frac{1}{2}} = 170$..............(1)

and $\tan \theta = \dfrac{Lp}{R} = \tan 45° = 1$

$$\therefore \frac{Lp}{R} = 1 \text{ or } Lp = R \text{....................(2)}$$

Substituting this value of Lp in (1) we get

$$(2R^2)^{\frac{1}{2}} = 170.$$

$$\therefore R = Lp = 120.19.$$

Assuming that the maximum value of the alternating current e.m.f. is 1 volt [If 1 volt is the virtual value of the alternating e.m.f., the maximum e.m.f. is 1.414 volts.]; then the maximum current through the combination consisting of inductance L, resistance R and capacity K in series is given by

$$I_m = \frac{1}{\sqrt{R^2 + \left(Lp - \dfrac{1}{Kp}\right)^2}}$$

---

* Books recommended are *Questions and Solutions in Telegraphy and Telephony, Final Grade,* by Few (Rentell, 2s. 2d. post free), and *Practical Telephone Handbook,* by Poole (Rentell, 15s. 6d. post free).

Substituting in this expression the values of R, L, K and p given, we get

$$I_m = \frac{1}{\sqrt{(120.19)^2 + \left(120.19 - \frac{1{,}000{,}000}{5000 \times 2}\right)^2}}$$

$$= .0082 \text{ amps.}$$

The maximum *P.D.* across the Receiver

$$= \text{Max Current} \times \sqrt{R^2 + L^2p^2}$$
$$= .0082 \times 170.$$
$$= \underline{\underline{1.394 \text{ volts.}}}$$

The maximum *P.D.* across the Condenser.

$$= \text{Max Current} \times \frac{1}{Kp}$$
$$= .0082 \times \frac{1{,}000{,}000}{5{,}000 \times 2}$$
$$= \underline{\underline{.82 \text{ volts.}}}$$

(To be continued.)

THE ADVANTAGE OF AIR HEATING.*

(FROM A CORRESPONDENT.)

The advantages of air heating have been proved in a very conclusive manner by Mr. C. W. E. Clarke in his elaborate paper, read several months ago before the American Society of Mechanical Engineers at their annual meeting in New York, reprints of which are now available. Mr. Clarke is, of course, well known as the designer of the Colfax Station of the Duquesne Light Co., Pittsburgh, and one of the foremost American experts on combustion, and the above paper gives a mass of data relating to a series of elaborate tests of 24 hours each, with 15-minute readings, carried out continuously for about three weeks on a large water-tube boiler at Colfax, with and without air heating. The boiler was of the large cross drum type, of 22,914 square feet heating surface, having a normal (100 per cent.) evaporation of 97,000 lb. of water from and at 212 deg. Fahr. per hour, with 140,000 lb. overload, working at 275 lb. gauge pressure.

The superheater was 2,999 square feet heating surface, whilst no economisers are fitted because of the low price of the coal. The air heater installed was of the "Usco" type, raising the temperature of the incoming cold air from 60 deg. Fahr. to 235 deg. Fahr., the final chimney gas temperature being only about 240 deg. Fahr., whilst the stokers used were of the Westinghouse multiple retort underfeed type of very large size with 17 retorts.

The results of the huge number of readings are given in the forms of a series of curves, and the net result is that air heating increases the over-all efficiency of the boiler plant about 5 per cent at normal rating (that is, 7½ per cent. saving in the coal bill), being, for example, 5½ per cent. at 114 per cent. rating and 7 per cent. at 200 per cent. rating. The efficiency of the combustion is considerably increased in various ways. For example, the average exit temperature of the flue gases from the boiler and superheater is reduced 10 deg. to 18 deg. Fahr., depending on the rating, in spite of the fact that hot air at 235 deg. Fahr. is entering the furnace in place of cold air, caused by the increased emission of radiant heat, whilst also the CO_2 in the exit flue gases is increased by 0.7 to 1.4 per cent. Further, the amount of unburnt fuel in the ash and clinker is 6 to 12 per cent. less and the fuel ignites more easily in the stoker retorts, whilst the fuel bed is more uniform. The amount of power required by the air heater was found to be 5 k.w. per ton of coal burnt, equivalent to approximately 0.4 per cent. of the steam production of the plant. The net results are so extremely satisfactory that it is stated over £200,000 worth of "Usco" air heaters have already been ordered for American power stations, although Colfax was the first to adopt this principle. The "Usco" air heater is of the vertical multiple plate type operating on the contr-flow principle, and is, of course, a British invention, having been patented originally by Messrs. The Underfeed Stoker Co., Ltd., in 1911, and is already installed in a number of British stations, such as Poplar, Central London, and Northampton. There is no question, however, that a big development on these lines will also take place in Great Britain, and the principle is of equal importance for all types of boilers, being applicable, for example, to the ordinary "Lancashire" boiler plant, which on the latest principles would consist of superheater for heating the steam, economiser for raising the temperature of the feed water, and, finally, air heater for increasing the temperature of the incoming air to the boiler furnace, whether air or mechanically fired

As showing the part played by the air heater as applied to a modern mechanically fired water-tube boiler of, say, 60,000 lb. (actual) evaporation per hour, we have the following approximate figures. The heating surface of the boiler is, say, 8,600 square feet, the superheater about 3,200 square feet heating surface, the feed-water economiser, say, 4,500 square feet, and the air heater something like 9,000 square feet. Under these conditions, with a flue-gas temperature leaving the boiler and superheater together of 650 deg. Fahr., the gases are reduced to 400 deg. Fahr. after passing through the economiser, and finally to only about 240 deg. Fahr. after the air heater and on discharging to the chimney. The average water-tube boiler practice to-day, without air heaters, is probably, as regards chimney-base temperature, about 300 to 400 deg. Fahr., whilst for "Lancashire" boiler the figure averages at least 400 to 500 deg. Fahr. The cold air, circulated by means of a fan and trunking, enters the heater at about 60 deg. Fahr., and is raised to about 200 to 250 deg. Fahr. before being discharged to the mechanical stoker furnaces. The performance figures of such an installation will then be about 65.5 per cent. of the heat in the coal absorbed by the boiler, 10.5 per cent. by the superheater, 7 per cent. by the economiser, and 4.25 per cent. by the air heater—that is, a total of about 87 per cent., representing, of course, a very high net efficiency.

Labour Dispute.—The recent strike which occurred at the works of the Hart Accumulator Co., Ltd., Stratford, has now been settled. The employees' demand was that they should be paid for statutory holidays and that they should be granted one week's holiday annually with pay. The Hart Company could not agree to this, and the men came out on strike on March 12. The strike lasted seven weeks, but at the end of that time the men withdrew their demands and offered to resume work. The Company had filled a number of the vacancies created by the dispute, but 160 of the old employees were re-engaged last week, and the remainder will be absorbed as soon as this is possible.

---

* Mr. C. W. E. Clarke's paper before the American Society of Mech. Engineers.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of
CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application, Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

More Wembley.

Slow but steady progress is being made with the electrification of the Exhibition, and, on the whole, there is rather more light after sunset than there was this time last week. Much remains to be done, however, before the buildings and grounds can be regarded as well and attractively illuminated. The famine in direct current is still as serious as ever, and those exhibitors who have had to rely upon outside battery-charging facilities are still further handicapped by the later regulations affecting lorries, which are not allowed to stay more than five minutes in a given spot to deliver their goods, and must not be left by the driver. Undoubtedly a bit more ginger put into the work of wiring and jointing would help things generally, for the public find little attraction in the evenings inside vast buildings which are indifferently illuminated.

While on this subject, I feel in duty bound to say that, from "information received," our good friends of the C.M.A. seem to have exonerated themselves so far as they are concerned, and, what is more, I have every reason to think they lent very valuable assistance to the Exhibition authorities in the way of smoothing over certain difficulties in regard to labour whch were really at the root of the trouble, while they are naturally in no way responsible for the sins of omission or commission on the part of various important exhibitors. It is but fair to the C.M.A. to give them all the credit which is their due for work done under difficult circumstances, and the same remark applies to Messrs. Sparks and Partners, the consulting engineers, who have worked nobly to get things shipshape without undue delay.

Unfortunately, the absence of juice in certain quarters is having its effect upon exhibitors, who see little benefit in keeping their stands open and their staffs on duty in sparsely attended avenues for the sole benefit of the few who are sufficiently interested to promenade these ill-lighted gangways. Attendances have been highly satisfactory so far in spite of the somewhat unseasonable weather, which no doubt prevents many would-be visitors from going to Wembley until they can do so in warmth and comfort. On one or two days last week the weather was arctic, and the only passably warm spots were those in the vicinity of the electric heating exhibits, together with the gas-fire and cookery section.

In the Palace of Engineering most of the unfinished stands and exhibits have been brought up to date, but many "stunts" still await the essential energy to operate them, although one over-zealous stand attendant has rediscovered the nerve-racking attributes of an engine-room klaxon, which he vigorously operates at frequent and irregular intervals, much to the annoyance of both public and contemporary stall-holders. One can accustom oneself to the hum of turbos, the ringing of bells, telephone and other varieties. But the raucous klaxon is bad enough when sounded by the high-spirited motorist in the open country, without treating innocent visitors to the Palace of Engineering to its discordant din. I prophesy an early official objection to this over-assertive advertising "stunt," and a speedy silencing of the offender.

The humorous side of the show strikes every observant visitor. I watched a box-nailing exhibit the other day, and I have never seen an ordinary hammer wielded to better effect by one of the operators who was apparently finishing off some work which the machine had temporarily rejected. Then the turnstiles; they are simply a scream, and I very much doubt whether anybody with a "corporation" could pass them sideways. I foresee a day of considerable congestion, when all the fat folk will be left outside and only the thin and moderate figures secure entrance. I understand that there is no truth in the rumour that visitors have to condition themselves by semi-starvation prior to passing the turnstiles, and that subsequently Messrs. Lyons guarantee to bring them up to normal in the various restaurants before passing through the exits, which are wider.

That the Exhibition is already doing good to some trades is evident from my own experience. I recently visited one or two leading furniture emporiums in London with a view to purchasing certain chairs for an exhibitor friend. Two of these concerns had none in stock, and could not promise delivery of the kind I wanted in less than ten days, as they were working at full pressure filling orders for similar furniture for the Exhibition. In spite of the lengthy notice of this world's greatest show some trades do not appear to have thought well ahead, or possibly they have not cared to take the risk of a poor demand for articles likely to be in big demand. At all events, they are doing well now, and even the local shops in the vicinity of Wembley and its environs are more often than not sold out of common requirements. The Exhibition is really a self-contained city in itself, with corresponding requirements and an enormous regular staff. These facts would appear to be only just dawning on some of the slower-thinking tradesfolk.

Getting There and Back.

On the whole, the arrangements made by the railway and other transport authorities are excellent, and there is an ample service of trains and 'buses. At Wembley Park, however, a platform indicator would be an inestimable boon, and save the hard-worked staff a good deal of unnecessary verbiage. There are several platforms, all of which are used fot the Baker Street service at times, in addition to their normal use for trains bound farther afield to Harrow, etc. In the present circumstances each platform attendant is provided with a time-table, which he consults all day, keeping himself *au fait* with train and platform associations. The ticket inspectors at the top of the stairs also do their little bit in directing the travelling public, with one eye on the clock and a memory for train times. In spite of these superhuman endeavours it is not always possible to avoid errors, and a frantic rush by a hundred or more passengers up one flight of stairs and down another to catch a train which has come in at an unexpected platform is quite a common occurrence. A platform indicator at the stairheads would save much verbiage and irritation.

The Never-Stop Railway.

Would-be passengers on this novel line inside the Exhibition grounds have not yet had an opportunity of sampling its capabilities, as up to the time of writing it has not started. Some wags have re-christened it the "Never-Start" Railway, but this is scarcely fair to the authorities, who have, I understand, been faced with various difficulties, not the least of which has been the flooding of certain sections, and the consequent drowning out of the motors, etc. These have had to be dried out and re-tested prior to placing in service, and there is little doubt that the Never-Stop will very soon be in commission. It operates on a very ingenious and simple principle, power being transmitted to the cars through the medium of a continuously rotated shaft, having around its periphery a thread of varying pitch. The latter is short in the vicinity of the stations and lengthens out between. A frictionless clutch device on the car engages with this thread, and the cars literally follow the thread of the screw, their linear speed varying according to the pitch

A Cardiff Enterprise.

Congratulations to the South Wales Electrical Power Distribution Company upon its enterprise in promoting an electric café in Cardiff. The café is situated at 47, St. Mary's Street, and has been started for purposes of propaganda to users and prospective users of electricity in the home. One of its objects is to demonstrate the advantages of electric cooking by offering meals prepared solely by this means. Another function of the café is to serve as an effective setting for attractive electric light fittings, heaters, toasters and other electrical aids to comfort. In addition to a circular letter issued by the promoters announcing the advent of the new café, the E.D.A. have also prepared an effective postcard appeal to Cardiff residents and others, so that the original scheme bids fair to do for Cardiff and South Wales what the E.E. Exhibition is doing for London, viz., make the domestic possibilities of electricity better known. More power to you, S.W.E.P.D.C.! That's the stuff to give 'em.

Lighting—Sane and Otherwise.

Illumination by electrical means is constantly improving, not only as regards the actual source of light (and here the development is both towards higher c.p.s and economical wattage), but also in the direction of more efficient and artistic distribution of the light. And the wonderfully varied qualities of electricity are as much to the fore in illumination as in the wireless, motive and innumerable other uses to which it is put—for instance, the internal lighting of railway coaches and road vehicles, and the headlights of motor-cars. But although much care and expense is lavished on outlay, and oft-times remarkably effective results obtained, there is still far too great a tendency towards *glare*. Shop-window lighting (which used to be the worst example, and always held up as such in a tirade like this is becoming) has much improved in recent years.

I think that there is not yet anything like *general* care for the spectators' eyes. The temptation to use as much light as possible seems to be irresistible, although with plenty of light to play with, so to speak, one could well afford to tone things down somewhat. There *is* a limit to what the human eye can withstand, and I am certain that eye-strain produces in the spectator of a shop or advertisement display just that little feeling of impatience which makes all the difference. And it must be remembered that the unshielded light from a brilliant filament contains certain more or less injurious rays.

A rather interesting commentary is afforded at a meeting of the Burnley Town Council, where a Mr. Broadley said that tramcar drivers were complaining of the detrimental effect on their eyes of the brilliant lights used by motor-cars. The Town Clerk was instructed to write to the Automobile Association on the matter. When I first read the account of above I felt inclined to scoff at the idea of *tramcar* drivers complaining, but, after all, surely they must have a lot to put up with? And one must admit that they are in a rather defenceless and even undignified position.

Lighting-up the "Lower Creation."

While on the subject of lighting, I might as well mention that so-called "electric daylight" has been provided in the new aquariums under the Mappin Terraces at the Zoo, and by means of Siemens lamps electrical illumination gives itself a very effective object lesson, so well has the installation been carried out. Each of the 95 tanks has been specially lighted, the bulbs being so tinted as to give an approximate daylight effect. This, I think, is the sort of useful and yet unobtrusive work which the electric lamp can do—and do so well. Who hasn't heard of the old "stunt" of putting lamps in the fowl-house, switching them on at some ridiculously early hour, and by such awful trickery bringing up the egg output? The Westinghouse Electric Co. recall this in a booklet which they have just issued, and which incidentally (so guileful is its editor) goes on to tell you of their successful method of heating incubators electrically and speeding up the output of chickens. What with all this and other electrical devices for milking cows and so on, plus Summer Time (though with no sign of spring, let alone summer !), I do really think that the farmyard inhabitants are having a very upsetting time.

Harnessing Vesuvius.

I notice with much interest an article on this subject in a recent issue of *Popular Science Siftings*. The suggestion made is that immense boilers should be sunk deep in the ground in the immediate vicinity of this and other volcanoes, from which steam would be generated and piped to turbo-generators, from which light and power can be distributed over many miles of territory. This scheme is represented to have been planned by Sir Charles Parsons, and it makes me think of W. L. Alden's tales about Prof. Van Wagener, of New Berlinopolisville, who was great at inventing such novelties as incandescent cats, electric glass eyes and scientific burglar alarms, as well as the volcanic valve, in which latter yarn the idea was to cause a volcano to erupt at certain fixed periods so that visitors could be charged a fee for seeing the eruption and thus produce a steady income for the company which was to undertake the scheme. It was tried out at Krakatoa, and was not quite the success anticipated by the dear old Professor, because, according to the yarn, it caused the explosion which is a matter of history. It is a capital tale, and makes me wonder how they will get on with the scheme referred to in our contemporary. I shall certainly watch developments with the keenest interest.

ELEKTRON.

Meeting.—A meeting of the Inst. of Welding Engineers will be held in the Lecture Hall of the I.E.E. on Wednesday, 21st inst., at 8 p.m., when a paper entitled "Power Supply for Electric Welding Operations" will be read by Dr. J. H. Patterson, F.I.C., followed by a discussion.

Finance.—The Johnson and Phillips balance-sheet shows a further increase of trading profits of about £12,000, and the dividend will again be 5 per cent., with an increased amount of nearly £25,000 to be carried forward. Altogether a very healthy and satisfactory report, on which the management can be most cordially congratulated.

Summer Meeting.—The Western Centre of the I.E.E. will hold a summer meeting at Torquay during the week-end commencing Friday, May 23. The provisional programme represents what should prove a very enjoyable outing at a modest figure. Full particulars may be obtained from the hon. sec., Mr. A. J. Ostler, The Exchange, Corn Street, Bristol.

Works Visit.—The members of the Birmingham and District Electric Club have been invited to visit the works of the Metropolitan Vickers Co. at Trafford Park, Manchester, on Wednesday, May 21, and the club committee hope that as many members as possible will avail themselves of this opportunity of inspecting these world-famous industrial works. Full particulars may be obtained from Mr. N. Deykin, hon. sec., 103, Station Road, Wylde Green.

Kelvin Centenary.—The members of the Kelvin Masonic Lodge, No. 3,736, will hold a special centenary meeting on June 20 in order to commemorate the birth on June 26, 1824, of William Thomson, Lord Kelvin. It is certain that this commemoration meeting will be of interest to all engineers who are members of the craft, and the Worshipful Master and brethren of the lodge will be pleased to welcome all those who would like to associate themselves with the celebration. Full particulars may be obtained from the secretary, Mr. H. W. S. Rentell, 36, Maiden Lane, London, W.C.2.

Strong opinions often mean weak intellects.

"ELECTRICITY SUPPLY IN WAR-TIME, AS AFFECTED BY THE IMPROVEMENTS IN HEAVY-OIL ENGINES."

At a meeting of the Diesel Engine Users' Assocn., which was held on May 9, a paper on this subject was read by Messrs. A. H. Dykes and W. T. Townend. The authors referred to the present-day tendency to replace the existing smaller local stations throughout the country by large capital stations serving by means of high-tension feeder cables very large areas, the original stations in which were gradually to become mere sub-stations or transformer stations. Although in connection with these bulk supply schemes every precaution was taken by duplication of plant and sectionalisation of units to ensure continuity of supply in all ordinary circumstances, the question arose as to what was likely to happen in the event of war. The destructive effects of air raids carried out in the late war were still fresh in people's minds, and, when due consideration was given to the great developments which had taken place in matters relating to aerial warfare within recent years, it was possible to conceive what would be the effect on capital stations fully exposed and well marked if enemy squadrons were able to penetrate the country's defences. The authors were of opinion that, if such dangers had to be taken into account, the only practicable way was to provide a certain number of underground generating stations driven by heavy-oil engines. The choice of suitable sites for such stations was not limited by the necessity of access to large volumes of water for condensing, and, as the stations could be placed in the centre of the load, the cost of trunk mains and sub-stations could be avoided. It appeared to be clear that Diesel stations must rely on petroleum oil as their fuel, as under normal conditions the demand for tar oil or creosote for timber preserving, etc., was sufficient to absorb the entire quantity produced. By the use of submarine tankers, however, it could be safely assumed that even in war-time suitable supplies of petroleum fuel would be available.

Dealing with the question of capital costs, the authors had submitted a comparison of the estimated capital cost of providing a Diesel-driven underground station of 17,500 k.w. capacity with that of an existing modern provincial capital station equipped with two steam turbines, each of 10,000 k.w. capacity. It was maintained that, when to the cost of the capital station was added the cost of the necessary trunk mains, the moderate-sized Diesel-driven station could compete even on the basis of capital cost.

The estimated running costs of the same Diesel-driven underground station were compared with those of a particular generating station scheduled for development as a capital station. The authors pointed out in connection with the item of running costs that the heavy-oil engine showed a great saving in wages owing to the elimination of any boiler-house and ash-handling staff.

The authors were of opinion that there were many engineers not actually familiar with modern heavy-oil engines who held exaggerated ideas on the cost of upkeep and liability to breakdown. The reports on heavy-oil engine working costs, which had been published by the Diesel Engine Users' Association, and which had been based on particulars of costs obtained in actual practice, were ample evidence that there was no more trouble in the matter of repairs and maintenance with heavy-oil engine stations than with steam stations.

The paper excited a considerable amount of interest, and many members and visitors took part in the discussion that followed.

Copies of the paper, together with an account of the discussion thereon, may be obtained on application to Mr. Percy Still, joint hon. sec. of the Assocn., at 19, Cadogan Gardens, London, S.W.3.

ELECTRIC DRIVING OF A MODERN FACTORY.*

By F. W. Smith, N.A.S.E.

(*Continued from page* 250.)

Varying the Supply Voltage: One printing office which I have in mind still employs this method of speed control: to what extent it is used I am unable to say. They have, as far as I can remember, a five-wire system, which gives them 100, 200, 300, and 400 volts. The motors are wound for the maximum voltage, and proportional lower speeds than the top speed can be obtained by change-over switches to the lower voltage. This system is not generally adopted, and, of course, can only be used on a private plant. I might add that this printing office has recently installed a number of motors for individual drives with full automatic control, which leads one to believe that they, too, see the advantage of the automatic control over that of the five-wire system.

Shunt Field Regulation: This is without a doubt the best method of speed control, as the cost of running is practically in proportion to the output of the press. A very wide range of speed can be obtained, which, I have said before, is directly under the control of the overseer.

Double Winding of the Armature: This method of speed control is not in very great use, but the system is briefly this: The armature is wound with two independent windings, with a commutator at each end of the shaft, and is really like having two armatures with only one core and one field. By connecting the armature windings in series or parallel, full and half-speeds can be obtained.

Platens.

These machines, although quite small compared with the flat-bed or rotary type, are very necessary in the printing office, and one usually finds them occupying very valuable space which could be used for some other essential purpose in connection with the department. It is rather extraordinary that these machines are invariably driven from a counter-shaft, and it is not unusual to find that with a group of five or six only two are actually required at one time. It must be obvious to you all that in such a case a considerable saving would be effected if they were individually driven. The reasons put forward by most printers are that these machines are slow running, and that the motors required for individual driving would have to be very slow indeed. There is, however, no difficulty in driving them off the fly-wheel, which is as a rule 36-in. diameter, and consequently fairly high-speed motors can be used; and if speed regulation of about 15 per cent. is given, they are turned into very useful little machines. Moreover, they can be fixed in any odd corner which would otherwise be filled up with ink-drums, etc.

Before going on to the rotary press, it would, perhaps, be advisable to give a brief outline of the printing machine in regard to its invention and the introduction of printing in England. Gutenberg invented movable type and the printing press in 1444. The first books were printed about 1457. It is sad to relate that, like so many other really clever men, he died in poverty. Printing was first introduced into England in 1474. No doubt the method then employed would have made it extremely difficult for individual driving.

Rotary Press Driving.

Although it was not my intention to deal with rotary press driving in this paper, I have been asked to say something to you on the modern methods of driving this type of press.

If one is to make a success of the electrical equipment, there are three essentials which must be kept in view, namely, reliability—simplicity—economy.

Reliability is absolutely necessary in newspaper work, and this must of necessity include provision for many things not wanted in ordinary flat-bed presses.

In order to avoid breaking the paper, and for the purpose of feeding-in, a very slow creeping speed is of vital importance, and this low speed must be capable of being maintained over very long periods during the preparation for printing, and it must be impossible for the motor to accelerate to a speed in excess of that required for the particular press that it is driving. It is extremely dangerous for the machine minder if there is any possibility of the machine creeping up in speed, as the minder very often in preparation occupies positions in the press which would most certainly lead to personal injury.

It must be possible to "inch" the machine without jerk, and there must be absolutely no doubt about "stopping" at any moment, whether the machine is "creeping," "inching," or at any other time during the run. A failure in this respect would be fatal, both to the attendant and the maker of the equipment.

When the plates have been fixed and the paper lead in, the press is accelerated from "creep" to the desired speed by smooth and easy acceleration. There must be no jerking or surging; likewise it is very necessary that the press can be run down again to any speed.

A considerable variety of speed is necessary on account of the different classes of paper in use, and the necessity of meeting any rush demand for print.

Another important factor is that a very high starting torque is required, in some cases 2½ to 3 times in excess of the running torque; then again, practically full-load torque is required at the "creep" speeds. The power required at maximum speed is, of course, far greater than that at "creep."

It must be obvious that the conditions in different offices vary, and that it is of importance that the system adopted is the best and one that will fulfil the three essential things mentioned before, viz., reliability—simplicity—economy.

Efficiency must not be confined to the running at full speed and full load, but must be maintained during the "inching" and "creeping" and running-up periods. So much time is spent in "inching" and "creeping" that inefficiency at these periods has led to the scrap-heap many systems which have otherwise been fairly successful.

---

* Lecture delivered before the N.A.S.E.

The control must be absolutely fool-proof, and it must be possible to "stop" and "lock" the press at any point round the machine. The press must be brought to rest quickly, but not suddenly, that is to say, it must stop in about 5 or 6 revolutions of the cylinder.

Although there are quite a number of rotary press drives, it is my intention to outline three of the best-known makes :—

Witton-James. Two-motor system.
Laurence Scott. Single-motor system.
Electromotors' "Gem." Motor-generator system.

(To be continued.)

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 180.

Can any reader inform me how I can obtain the value of the inherent reactance of an alternating current generator? I have no particular make of machine in mind, but current limiting reactances interest me and I cannot get any technical details.—"H. B. HURRY."

QUESTION NO. 181.

I wish to make up a condenser for a home-made wireless set with mica and tin foil. Can any reader give me constructional details, *i.e.*, thickness of mica, quantity of tin foil, and precautions to be taken?—"E. J. MORTON."

(Replies to Questions Nos. 180 and 181 must be received not later than May 31, 1924.)

Tenders Accepted.—The Admiralty have placed contracts for the supply of Osram Traction and Osram Gasfilled lamps with the General Electric Co., Ltd., and the Dublin Union has also placed a contract for six months' supply of the same well-known lamps.

Institution Awards.—The Council of the I.E.E. have made the following award of premiums for papers read during the session 1923-1924, or accepted for publication:—The Institution Premium to Lt.-Col. H. E. O'Brien, D.S.O.; Ayrton Premium to Mr. A Bachellery; Fahie Premium to Mr. P. E. Erikson and Mr. R. A Mack; John Hopkinson Premium to Mr. A. S. Fitzgerald; Kelvin Premium to Mr. H. M. Barlow, B.Sc. (Eng.), Ph.D.; Paris Premium to Mr. H. Marryat; Webber Premium to Mr. S. C. Bartholomew; Extra Premiums to Dr. A. E. Clayton, D.Sc. (Eng); Prof. W. Cramp, D.Sc., and Miss N. I. Calderwood, M.A., B.Sc.; Mr. F. J. Teago; Mr. E. A. Watson, O.B.E.; Wireless Premiums to Mr. R. H. Barfield, Mr. C. E. Horton, Mr. E. B. Moullin, M.A., Mr. L. B. Turner, M.A. The award of premiums for Students' papers will be announced later.

DEVELOPMENT OF THE BELLINI-TOSI SYSTEM OF DIRECTION FINDING IN THE BRITISH MERCANTILE MARINE.*

By COM. J. A. SLEE, C.B.E., R.N. (Ret.), Member.

(Concluded from page 249.)

The position is considerably improved in ships where a gyro-compass repeater is installed in the wireless room. In such cases a "true bearing indicator" is fitted whereby the bearing is read off on the face of the repeater instead of on the direction-finder scale, and the true bearing can be arrived at in one operation.

It is obvious that the measurement of "direction" is, in fact, a measurement of the direction in which the plane of the advancing wave-front lies, and if this is not at right angles to the line of advance of the wave the direction as observed will be subject to error. Any such distortion of wave-front must introduce errors which cannot be detected at the receiver, and the well-known "land effect" and "night effect" are the common manifestation of this wave distortion. Night effect is generally accompanied by an unusual "woolliness" of zeros, but there is nothing to warn the observer of land effect except the general track of the wave when laid off on the chart. This is clearly the business of the navigating staff, and not of the telegraphist, and more definite knowledge of the subject is required. Certain stations have a reputation for bad bearings, but there is not sufficient first-class evidence available to allow of a comprehensive statement being drawn up. It appears, in fact, as though land effect does not always occur, and certainly it varies considerably in extent. The general idea emerging from the records is that it occurs in two sets of circumstances :—

(*a*) When the line of bearing cuts a coast-line—high or low—at an acute angle, say, less than 20 deg.; and
(*b*) When high land intervenes close to the receiver or transmitter.

It may be remarked that, so far, no effects have been associated with ice or fog-banks.

An attempt has been made to overcome the difficulty of translating great-circle bearings into rhumb-line bearings by three methods: (1) Gnomonic charts are issued on which the great circles appear as straight lines; (2) a "half-convergency" table is issued from which the correction can be ascertained; (3) a "half-convergency" diagram is supplied from which the correction can be extracted. As a matter of navigation this correction is not of much value, as bearings at over 70 miles are seldom really used, and under 70 miles the correction is too small to be of any account.

It is worth noting that if two true bearings are laid off with station pointers on a gnomonic chart the result amounts to a three-point fix, because the true north point forms the third bearing.

When all is said and done, however, deep-sea navigation is not the proper zone of usefulness of a direction-finder.

The typical direction-finder as described gives an ambiguous result, there being no distinction between a bearing and its complement. In order to distinguish this point, direction-finder instruments are now fitted with a sense-finder, which is a form of the ordinary

---

* Paper read before the I.E.E.

"heart-shape" receiver. As fitted in most ships the heart-shape diagram is by no means true and the zero not as a rule good, and it is only used as an indication.

It is doubtful whether this sense-finding is of much real use for fixing the position of a ship, but it is very useful when working through cross-traffic in fog and has sometimes been of great value is helping to pick up a vessel in distress which has been badly out of her reckoning and has announced a very bad position.

All remarks on direction-finding have so far been made with sole reference to spark telegraphy. Bearings taken of continuous-wave stations are very crisp and clear, but the wandering due to "night effect" takes place at times to so great an extent as to make bearings of continuous-wave stations quite useless for navigational purposes. This is usually the case after dark.

If a sense-finder is used, and if the plain component is balanced so as to give an accurate zero, then the position of that zero is not subject to wandering. The chief trouble lies in the fact that the rate of reduction in signal strength is not the same on both sides of zero, and, therefore, the position of zero is not midway between the vanishing points. Hence it is practically impossible to fix the position of zero of a continuous-wave signal with sufficient accuracy for navigational purposes.

Trade Notes.

Radiola III. is the title of a well-illustrated 8 pp. pamphlet which has been issued by the **British Thomson-Houston Co., Ltd.**, and deals with their latest type instrument VA3. The description is clear and the illustrations give much information of direct interest to all wireless dealers, to whom we can recommend the pamphlet as illustrating an instrument in which business should be done with good clients. Copies may be obtained on application.

The Photector Co., Ltd., of 4-12, Palmer Street, Westminster, London, S.W.1, have taken over as from April 1, 1924, the business hitherto conducted by Messrs. Eck and Brook in bell, wireless and other transformers, "Kandem" electricity meters, lanterns for gasfilled lamps, "Excello" and other arc lamps, and accessories for them.

Lists 1024 and 1027 have been issued by **Simplex Conduits, Ltd.**, of Garrison Lane, Birmingham. The former gives details of various accessories supplied by the company, and is practically advance information for the use of their clients, pending the issue of a complete illustrated catalogue, while the latter gives the revised prices which have become operative since April 10. The company will be pleased to send these and any other publications issued by them to any reader who may apply.

The Midland Electric Mfg. Co., Ltd., of Barford Street, Birmingham, announce very important reductions in the prices of Baby Paragon switches, which should appeal directly to installation contractors in all parts of the kingdom as well as in the Colonies. The new prices, which are given in a neatly printed folder just issued by the company, came into force on the 1st inst., and we recommend application for copies of the list without delay.

From **Siemens Bros. and Co., Ltd.**, of Woolwich, we have received two new catalogues. No. 170, which is entitled "Jointing Materials," is a comprehensive price list of the company's well-known insulating tapes and compounds, including the following prepared tapes:—"Woolwich" adhesive, bitumen, indiarubber, superfine cotton, Ozokerite, etc.; Chatterton's compound, joint box insulating compounds, solders, flux, anti-sulphuric enamel, shellac varnish, etc., etc.——Catalogue No. 175 is entitled "Chain-Type Cable Hooks," and gives clear illustrations and prices of the Siemens patent cable hooks for supporting cables on walls. They are made in four standard sizes for cables up to 4 in. diameter, and consist of three different parts only. They can be arranged for supporting any of the usual sizes of cable in such number and arrangement as may be required.

Various Items.

Finance.—The report of the Urban E.S. Co., Ltd., for the year 1923, is again a very satisfactory document. Very ample allowances are made for depreciation, general reserve, and general expenses, after which it has been decided to pay a dividend of 4 per cent. per annum on the ordinary shares, carrying forward nearly £10,000 to the next account.

Imperial Cable Extension.—C.S. "Faraday" left the Woolwich works of Siemens Bros. and Co., Ltd., on the 7th inst. laden with a large quantity of submarine cable manufactured by the company and destined to form the extension of the Imperial Telegraph System connecting Turk's Island with Barbados, Demerara and Trinidad. The whole of the work is expected to be completed in June.

Railway Signalling.—Part II. of the Proceedings of the Inst. of Railway Signal Engineers from July, 1923, to January, 1924, has just been issued from the Institution Offices and may be obtained from the secretary or from the office of ELECTRICITY, price 7s. 9d. net, post free. It contains the full reprints of various papers on railway signalling, automatic telephone switchboards, and other items of interest to all readers of ELECTRICITY who are associated with railway work, and can therefore be recommended to their attention.

Pushing Sales.—An effective display to encourage the sale of small electric radiators was recently staged in a window of the Bradford City Electricity show rooms. The window trim was enhanced by a touch of whimsical humour representing a baby immediately after a bath enjoying the heat from the radiator and impressing on the spectator, in the words of a window ticket, "You can do with one of these in your bath-room," with the emphasis on the "you" and the "your." By very simple means the suggestion of a bath-room scene was presented, a screen with a representation of white tiles below and bold panels on marble above forming the background. In front a perky baby doll was seated on a white towel, beside a bath of water, with a towel round the doll's shoulders, suggesting that it was in the act of giving itself a good scrub. Facing the doll and about the floor of the window were the radiators, with the window ticket in front.

GRINDERS
DRILLS
"DEPENDABLE"
& POLISHING LATHES
MARRYAT & PLACE, ENGINEERS.
28 HATTON GARDEN, E.C.2.

VULMOS
GENUINE
VULCANIZED
FIBRE
MOSSES & MITCHELL, LTD.
12 [illegible] 124 GOLDEN [illegible]
LONDON, E.C.

Sample Pair Sent on Approval for 8/6

Made of Pure Para Rubber, soft and durable and unaffected by climatic conditions
DAVID MOSELEY & SONS,
Limited,
ARDWICK, MANCHESTER.

MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

MAY 23, 1924.

CONTENTS.

PAGE
The King's Message to the Empire 263
British Industries Fair 264
Clocks at Wembley 265
The W. E. Highfield Shield Competition 265
"Faithful Reproduction in Radio-Telephony" 266
Boots' Illuminated Signs 266
Current Topics 269
The G.E.C. at Wembley 272
Questions and Answers by Practical Men 273
Electric Driving of a Modern Factory 275
Reviews of Books 275
Various Items 276
Trade Notes 276

THE KING'S MESSAGE TO THE EMPIRE.

A TELEGRAPH RECORD.

In our issue of May 2 "Elektron" congratulated Mr. Cruickshank and the staff of the C.T.O. on the skilful organisation which enabled the King's message announcing the opening of the British Empire Exhibition to be flashed round the world in record time, and we now give the fuller details which were then promised. For these we are indebted to the current issue of the *Telegraph and Telephone Journal*, from which the article is reprinted *in extenso*.

What may be described with the strictest accuracy as the greatest telegraphic feat on record was performed in connection with the King's opening of the Wembley Exhibition. It was arranged that immediately after having opened the Exhibition the King should hand in a telegram conveying his announcement of the fact to the whole Empire. In order that this message might be conveyed throughout the Empire with the utmost celerity, negotiations were set on foot between the Post Office, the Pacific Cable Board, and the Eastern and Associated Telegraph Companies. At first the idea was that the precedent of the Diamond Jubilee should be followed, and that a press button should be arranged which the King would use to convey the signal throughout the Empire. On further consideration it was thought that it would be much more of a telegraphic feat if an actual message with the King's own words were transmitted, and not merely an indicative sign or symbol releasing the message. A wire was joined up from Wembley Exhibition, the Stadium Office, to the Central Telegraph Office, and placed at that office in close proximity to the Imperial Cables. A second line was joined by the side of it to the Eastern and Associated Telegraph Company's office in Moorgate Street. After consideration it was decided that the message should be sent round the Empire from west to east. Thus the route was Wembley; Central Telegraph Office; Halifax, Nova Scotia; Montreal; Bamfield, Vancouver; Fanning Island; Fiji; Auckland, New Zealand, and Sydney. At that point the work of the Post Office, the Imperial Cable, the Canadian Pacific Railway, and the Pacific Cable Board, came to an end. The message was then to be telephoned across Sydney to the offices of the Eastern and Associated Telegraph Companies; and on the homeward journey it came by three routes simultaneously and for a portion of its journey by four routes. It touched Cocos, Rodriguez, Durban, Cape Town, St. Helena, Ascension, St. Vincent, Maderia, and also from Sydney to Singapore, Madras, Bombay, Aden, Suez, Alexandria, Malta, Gibraltar. Thus it came home by a triple route to England, and the office of the Eastern and Associated Telegraph Companies had the curious experience of receiving the message almost simultaneously to a second by four different routes.

Probably the most dramatic event of the whole proceeding was at the Stadium office at Wembley. Here the prominent Post Office officials, who were in charge of that section of the work, had the curious experience of watching two telegraph instruments. On one of them the message went out immediately the flags were unfurled, and at the other in the space of 89 seconds the message was received, having gone round the world. Then, carefully written on an Eastern Company's telegraph form, it was delivered by a Post Office messenger and a map of the route was enclosed for the information of the King. The dramatic scene when the boy walked with appropriate dignity along the passage and saluted, and passed up the steps and again saluted, has been noticed by most of the correspondents on the spot, but what perhaps they have not heard is the fact that the King remarked, "That boy did his work well." It is not at all inappropriate to widen the interpretation of the King's phrase to include the whole of the telegraph workers on the route.

It is desirable to explain how the message was conveyed. Practically the whole route with 17 transmissions on the direct journey was worked by Wheatstone, or by adaptations of Wheatstone to syphon working still using the Wheatstone transmitter. The exact wording of the message was: "I have this moment opened the British Empire Exhibition.—George, R. and I." That message was punched at Wembley with the simple prefix CQ, and without any other preliminary indication. Immediately the letter "I" was reached at the Central Telegraph Office the punched slip was put on the Halifax transmitter and this was followed throughout the whole route. An ingenious calculation has shown that before the last word was received in the Central Telegraph Office the first word was being telegraphed to Cape Town. A very interesting point may be mentioned in connection with a second telegram. In order that the whole of the route might know the transit-time of this historic message, a second slip was punched, "CQ, for publication, transit-time King's message 80 seconds." This message had not been pre-arranged, and it reached Australia inside two minutes, so that not only the King's message, but the knowledge of the speed with which it had been transmitted had been broadcasted over the Empire within 3½ minutes from the unfurling of the flag. Including the act of delivery and the boy's celebrated walk along the track in the eyes of 100,000 people, the total time which elapsed from the unfurling of the flag to handing the telegram to the King was 2 minutes 20 seconds.

BRITISH INDUSTRIES FAIR.

A visit to the British Industries Fair (Birmingham Section) held at Castle Bromwich is disappointing to the electrical buyer. Very few firms are showing, and several of those who have previously exhibited at Birmingham are not represented this year, probably due to the fact that they have stands at Wembley. The exhibits are practically confined to electric light fittings and accessories, heating apparatus, small-house lighting plants and electro-plating equipment. Messrs. J. H. Tucker and Co., Ltd., of Birmingham, have a good display of electric light and power accessories, ironclad, teak cased and open type switches and fuse gears, switchboard, etc. In addition to a great variety of their well-known "dome," "flat," "semi-recessed" and "sunk" pattern of tumbler switch, they are showing a new quick make and break flat tumbler switch of improved design. Its chief merits are encased compression spring, direct positive drive throughout the stroke, simplicity, robustness and an arcing partition of generous dimensions, the terminal screws and dead parts being arranged in a remote position from where the actual arc takes place. Other flat type of switches include intermediate switches, for controlling the same light from any number of points, series parallel switches for varying the grouping of small motor windings or dimming lights by connecting in series, and D.P. switches for low voltage circuits. A practical demonstration of the effects that can be obtained with these switches is given on the stand.

They are also making a special feature of some moderate-priced accumulator switchboards which are of well-thought-out design and of very high-class finish. These boards can be supplied with S.P. or D.P. switches and one or two ammeters. They are standardised in 15, 25 and 50 amp. size, and 25, 50, 75 and 100 volts, while larger boards are available for 15, 25, 50, 75 and 100 amps., and 25, 50, 75, 100 and 150 volts.

Messrs. Tucker are also showing a comprehensive range of quick-break ironclad switches, both of the ordinary enclosed and the quick-make watertight pattern, while another feature of their stand is a three-pin plug and socket in which the third pin is used for earthing purposes on various portable apparatus. They are available in ironclad (ordinary and watertight) wall or floor patterns. In addition, they have a 15 amp. two-pin wall and floor plug and socket of new design which conforms with the British Standard Specification.

Messrs. R. A. Lister and Co., of Dursley, are exhibiting their automatic electric light and power plants. The 1 kw. and the 1½ kw. belt driven lighting plant for country houses, farms, clubs, etc., is a very compact, well finished equipment of good design at a moderate price. The engine is their well-known slow speed single cylinder verticle water cooled four-cycle type fitted with H.T. magneto and automatic lubrication. The governing is effected by means of a very sensitive centrifugal governor which operates with extreme efficiency—an important point in connection with a lighting plant. This engine can be used for driving any other machinery within its capacity.

The shunt-wound dynamo is of the four-pole protected fan ventilated type, fitted with ball bearings and having a temperature rise not exceeding 72 deg. Fah. above the surrounding atmosphere. The switchboard, of enamelled slate, is also particularly neat and compact, and is fitted with voltmeter, ammeter, voltmeter switch, auto "cut-out," four-way charge switch, four-way discharge switch, D.P. switch and fuse for dynamo and D.P. switch and fuse for lights.

A comprehensive range of electro-plating plant is the speciality of Messrs. W. Canning and Co., of Birmingham. They have several ranges of low-voltage generators and motor generator sets, and are making a special feature of electrically heated enamelling stoves. That electro-galvanising is making considerable headway and that its rust-proof qualities are equal to the hot process is clearly seen from a visit to their stand. In addition, examples of the deposition of cadmium and the much-talked-of new deposit of chromium are on view for those interested.

Messrs. John A. Harry Hunt, of Birmingham, have some very fine samples of good-class electric light fixtures, art metalwork, illuminated signs, etc. Their lamp fittings in particular are artistic, extremely attractive and very well finished. A particularly interesting device is their "Spidorlite Tripod" body for use with alabaster bowls, moonstone or other heavy glass bowls. We all know the unsightly effect that is obtained with the usual system of semi-indirect lighting where the bowl is suspended by three chains with the flex carrying the lamp hanging down the centre. With the spidorlite tripod, which consists of a wire cage capable of holding three gasfilled lamps totalling 180 watts, this eyesore is eliminated. The cage stands on three legs inside the bowl, the necessary leads being brought down the suspending chains. No sign of the lamps can be seen, and the arrangement of the lamps is such that no shadows are thrown downwards nor are they close enough to the bowl to cause any risk of burning valuable alabaster.

A large variety of first-class electric lighting and power accessories, such as tumbler switches, plugs and sockets, ironclad switches and fuses, fuse boards, etc., are being shown by Messrs. Wandsworth, of Birmingham. A fitting that will appeal to contractors who have experimental trouble when installing fittings where the box is sunk into the plaster is the "Wandsworth" box, in which the level of the switch can be adjusted by a few turns to four adjusting screws. Another feature of the stand is a fuse fitted with a springless automatic arc-breaking indicating device and self-aligning contacts.

Some interesting examples of portable radiant electric furnaces are to be seen on the stand of Messrs. R. M. Catterson-Smith, of London. They are of extremely simple design, have a long life and very low power consumption. The maximum temperature is 1,000 deg. centrigrade, the heat being obtained by nickel chromium elements in panels of carborundum. A variable resistance is provided for temperature regulation.

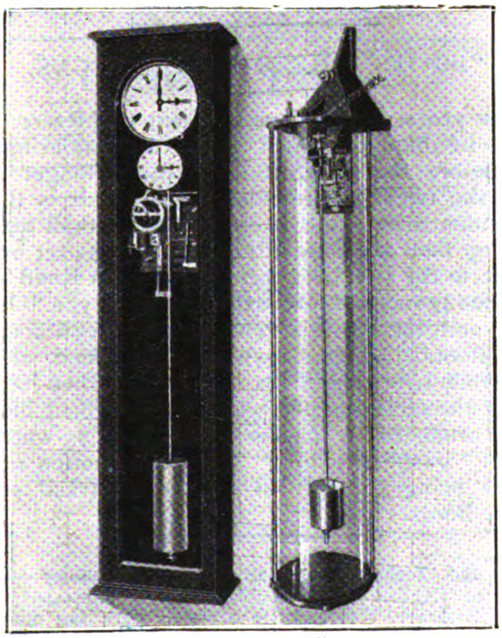
Messrs. Sturge and Baker, Ltd., of Birmingham, have a large range of accessories designed to carry heavy currents, and are meant for use primarily in engineering works. Several new types of electric fires are exhibited.

When one hears of a firm being engaged in the manufacture of electric heating and cooking appliances for seventeen years one naturally expects to see goods that are excellent in every way. An examination of the stand of Messrs. Premier Electric Heaters, Ltd., of Birmingham, fulfils one's expectations. They have an excellent show of electric fires, kettles, flat irons, saucepans, radiators, etc., whose attractive and well-finished external appearance is only equalled by the robustness and perfect construction of the interior. Every article is designed with the object of appealing to the artistic taste and at the same time to give good useful service.

The Rawlplug Co. has its usual display of "Rawlplugs." Wireless components are shown by Messrs. S. A. Lamplugh, The Birmingham Products, Ltd., Wilkes and Wright, Ltd., and The M.A.P. Co., while Messrs. Leslie G. Russell have a large collection of synthetic and natural crystals for radio rectification. Messrs. C. H. Parsons, Ltd., are showing tumbler switches, lamp-holders, etc., while the Paragon Rubber Manufacturing Co. have numerous samples of insulating materials and insulators for high and low tension work. Electrically-driven machines for dust removal are exhibited by Messrs. Oscar T. Baker, of Bolton, and The Wolseley Sheep Shearing Machines Co. are showing a range of house-lighting sets.

CLOCKS AT WEMBLEY.

Much has been heard lately in scientific circles of the free pendulum, a development of the synchronome system of electric clocks, which has surpassed every known record of accuracy in time measurement. It was the subject of a lecture by Mr. F. Hope-Jones, M.I.E.E., at the Society of Arts last month, and was exhibited at the Royal Society's Soirée on the 14th instant.



SLAVE. FREE PENDULUM.

To those who have any knowledge of clock escapements the idea of a perfectly free pendulum is fascinating. It would appear to be impossible, on the face of it, to devise a means of giving impulse to a pendulum which shall not require that pendulum to unlatch or release a small instalment of the reserved store of energy. The very word escapement implies it, yet it is nothing less than this which has been accomplished.

The solution of the problem lies in the use of a slave clock to perform this duty for it. It is enabled to do so at precisely the right moment, because its pendulum is kept in perfect phase synchronisation with the free pendulum.

Two examples of the free pendulum are to be found at Wembley—one in the Royal Society's exhibit in H.M. Government Building, and the other, which is the subject of our illustration, in the exhibit of the British Horological Institution in the Palace of Industry. The latter is used as the fundamental timekeeper of the twenty large electric clocks which serve the Palace of Industry, the Conference Hall, and adjacent buildings in that part of the British Empire Exhibition.

These clocks have been exhaustively tested at the Royal Observatory, Edinburgh, throughout the last two years by means of special apparatus, including a cinematograph, which takes cognisance of thousandths of a second. It is only by such means that any error has been discovered, and the variations have never exceeded one-hundredth of a second in twenty-four hours.

THE W. E. HIGHFIELD SHIELD COMPETITION.

The second annual competition among the members of the National Association of Supervising Electricians for the W. E. Highfield Shield provided those who attended the meeting at the St. Bride's Institute, London, on May 13, with an evening's intellectual enjoyment.

The class of paper entered was well up to the average and again evidenced what members can do in this direction.

There were ten papers submitted with the following titles:—

1. A Summary of the Electrical Equipment of a Motor-car.
2. A Few Suggestions.
3. Electrical Advertising.
4. The Transverter.
5. Installation Work in Practice.
6. Maintenance and Fault Finding.
   3-phase, A.C. Induction Motors & Control Gear.
7. Electric Butt Welders and Welding for Heavy Sections.
8. Continuity of Supply combined with Safety First.
9. The Layout of a Modern Repair Plant.
10. Electricity as Applied to Navigation.

The chair was occupied by the president, Mr. W. E. Highfield, and the reading of the papers entrusted to three members of the B.O.C.

As explained by the general secretary, the rules of the competition had been faithfully followed to secure the utmost fairness, and many were the surprises when the authors of the winning papers were announced.

The ballot vote resulted as follows:—

1st.—"Installation in Practice," by W. J. Revell.
2nd.—"Electrical Advertising," by R. W. Whitley.
3rd.—"Electricity as applied to Navigation," by R. W. J. Stark.

Mr. W. J. Revell was therefore the winner of the Shield and the first prize, a standard lamp, done in silver, representative of one of the lamp-posts at the British Empire Exhibition presented by the General Electric Co., Ltd. Mr. R. W. Whitley received the second prize, value £3 3s., presented by Callender's Cable Co., Ltd., and the third prize of £2 2s., presented by Mr. F. T. Alldread, went to Mr. R. W. J. Stark.

The special Associate Member's prize of £1 1s., presented by Mr. R. W. Whitley, was awarded to Mr. T. V. Harding for his paper on "Maintenance and Fault Finding."

The decisions were received with applause, and it was evidenced that the valuable work Mr. Revell has done for the Association had not been forgotten. It was, in fact, "a popular verdict," and Mr. Highfield in presenting the Shield said it was a personal pleasure to hand the Shield to one for whom he had the greatest admiration, and complimented the audience on its excellent judgment in deciding the winners and the winners on their papers.

Mr. Revell suitably acknowledged the Shield, and expressed his appreciation of all the president had said, and he was well supported by the second winner, Mr. Whitley.

It was noted with interest and gratification that Mr. R. W. J. Stark, of Edinburgh, winner of the third prize, won the second prize in the competition last year.

A vote of thanks to Mr. Highfield for presiding having been voiced by Messrs. Brammer and Windibank, during which reference was made to the retirement of Mr. Highfield from the office of president, and acknowledged by the chairman, the meeting closed.

"FAITHFUL REPRODUCTION IN RADIO-TELEPHONY."

A very interesting paper on this subject was recently read at the Institution of Electrical Engineers by L. C. Pocock, B.Sc., A.C.G.I., Assoc. Mem., who remarked that in view of the world-wide spread of present-day broadcasting, the faithfulness of reproduction in radio-telephony is a matter of vital importance. At the same time, it is one of considerable difficulty. Popular views upon voice and music reproduction vary enormously, and it, therefore, appears to be necessary, as Mr. Pocock suggests, that there should be some standard measurement of intelligibility.

The most vexed question, of course, is the loud-speaker, but with these a wonderful advance has been made, even during the last twelve months, although they do owe their success, as Mr. Pocock suggests, to the generous tolerance of the human ear.

We give below a summary of Mr. Pocock's paper, which should be referred to by all interested in radio-telephony development.

A most complete bibliography on the subject adds very considerably to the value of the paper, as it includes references to many books and works, to which the engineer in the ordinary way would possibly have no reference or access.

SUMMARY.

On account of the great number of processes and transformations that energy undergoes between its acoustical source and the ear of a listener when wireless telephony is the means of transmission, it is not possible in a single paper to explore in detail all the avoidable and unavoidable possibilities of distortion. The proper understanding and application of certain general principles enable individual circumstances to be examined and indicate the path to be taken in the pursuit of high-quality transmission.

In this paper, therefore, an attempt has been made, first, to define terms suitable to the scientific study of faithful reproduction; second, to analyse into separate constituents the types of distortion occurring; and third, to lay down the general principles above referred to and give them as far as possible a mathematical form. This has been done not only for the purpose of ensuring precision and definiteness of statement, but also to enable quantitative application to be made and to prepare a foundation on which to build as knowledge of the subject progresses.

Special consideration has been given to transient phenomena because in much of the apparatus used for radio-telephony the ordinary forms of steady-state distortion can be reduced to a negligible amount. The consideration given to transients is, however, of a preliminary nature only; it is not possible to develop the study of transients in this paper beyond the simple cases of "ironless" circuits. An interesting and difficult field left open for investigation by mathematical and experimental means is the exploration of transient phenomena in circuits having impedance operators that are not single-valued functions.

In Part II., the principal types of apparatus employed in radio-telephony have been considered in as general a way as possible.

A bibliography has been attached, where detailed investigations will be found of many matters touched upon but lightly in the paper, because the presentation of matter covering so wide a field seemed to exclude extended investigations that had already received very full treatment as self-contained publications.

"BOOTS'" ILLUMINATED SIGNS.

A few years ago the management of Messrs. Boots decided to illuminate their signs, and so bring their name before the general public for a longer period during the twenty-four hours. The result is that, in the London area alone, there are more than 50 signs delivering their message after darkness has set in. For example, in the sign over their Farringdon Road branch there are 147 100-volt, 10-watt, clear sign type "Osram" lamps, and the sign is remarkably conspicuous, the word "Boots" being shown in well-defined, clear-cut lines; while over their Cheapside branch they have two signs of the facia type, in which the excellent illumination is produced by means of 60- and 75-watt clear "Osram" gasfilled lamps. The electrification of these signs is being carried out by the electrical staff of Messrs. Boots.

Trade and Technical Journals Bureau, Wembley.—Readers visiting the Exhibition at Wembley will be interested to learn that the *Structural Engineer*, in common with the main technical journals, is an exhibit at the Trade and Technical Journals Bureau, Stand No. 277, in the Palace of Engineering.

Consult it at Wembley.—*Phillips' Monthly Machinery Register* (proprietors and publishers, Charles D. Phillips, Ltd., Emlyn Works, Newport, Mon.), which has been established over half a century, may be consulted at the Trade and Technical Journals Bureau, Stand No. 277, Palace of Engineering, Wembley Exhibition. It is a most useful medium to all buyers and sellers of all classes of machinery, both new and second-hand, including locomotives and all kinds of engines, boilers, machine tools, cranes, steam winches, pumps, fans, saw-mill equipment, and contractors' and colliery requirements. The subscription rates are 10s. per annum, or 6s. per half-year, post free. It may also be seen and purchased from Messrs. Rentell at their stand in Avenue 15, Bay 14, in the same building.

Politeness is the grease that lubricates the machinery of business.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of
CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription : 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

Wembleyitis. Have you been to Wembley yet? If not it is high time you seized an early opportunity of visiting the British Empire as concentrated so conveniently within easy reach of London. Most of the delays incidental to the first week or two after the formal opening have been overtaken, and whenever you go you may be sure of a splendid eighteenpenny-worth. From arctic last week the weather has suddenly turned to tropical, and the grounds at Wembley are putting on their summer colours day by day. It is quite a treat to sit in the open and listen to one of the many excellent bands which perform for the delectation of visitors. Although I attended most of the old South Kensington Exhibitions, I cannot quite reconcile the atmosphere of the B.E.E. with that prevailing at the Fisheries, Healtheries, etc. It may be a result of the bigness of Wembley and the large variety of vistas which appeal to the observant eye from all points of the compass.

One rather misses the illuminated fountains, colour effects, and festoons of lamps in the trees which were peculiar to these old-time exhibitions, but which the vastness and general lack of forestry at Wembley Park render impracticable. As it is, the grounds are very attractive at night, and will doubtless be more so as the season advances and more detailed illumination and other effects are added, from time to time. The flood lighting of the Indian section is very effective with its suggestion of a delicate pink glow on the white background of the facsimile Indian architecture, and one gets quite the Oriental atmosphere. Since writing last week I have also visited Canada, Australia, Malaya, Sarawak, and found plenty to interest and instruct in these representative collections of Empire products.

The "Walk-in-front" Habit. To the observant there is a peculiar tendency which was absent from the earlier exhibitions, and is probably a product of our modern civilisation and decaying etiquette. I refer to what I may aptly term the "Walk-in-front" habit, and it consists in a tendency on the part of any person or group who may be viewing any particular exhibit or stand, deliberately to walk in front of and thus intercept the view of those already looking on. It is very noticeable at Wembley, and one has to stand quite close up to the stand or rails to prevent other folk indulging in this habit, which, highly objectionable to the stationary visitors, is probably the outcome of habit or thoughtlessness. In any event, it is the reverse of good manners.

Enterprise. Things are much more advanced in the Palace of Engineering than when I last wrote. There are still a few unfinished exhibits in the B.E.A.M.A. section, although that devoted to the displays of the B.E.A. is practically complete, and has been so for the past week or two. In this connection the B.E.A. has set an excellent example by inaugurating a reference bureau to exhibits in the B.E.A.M.A. section. Any inquirers for electrical gear in that portion of the building set aside for ordinary engineering products will be passed on to the proper quarter. Is the B.E.A.M.A. going to reciprocate with a similar register of general engineering exhibits for the guidance of inquirers in the B.E.A.M.A. section ?

The Telephone Service. The telephone service at the Exhibition is still atrocious, and in the presence of the smoothly working exhibits of automatic telephony with no delays, no wrong numbers, and instantaneous disconnection, one finds plenty of food for regret that the automatic system could not be installed in time for the actual service between the Exhibition and the outside world. Getting through even to local London numbers calls for a maximum of patience and a total disregard of time, whilst Trunk calls are absolutely hopeless. I was rung up from Liverpool the other day, and my correspondent might have been talking round the globe by high capacity underground cable, for all I could make of his voice.

I caught scraps of the message here and there by which I ultimately identified the speaker, and drew upon my imagination for the gist of the message. I don't know what the trouble is, but I imagine inefficient junctions and resultant terminal losses to be at the bottom of it. Coupled with this lack of clearness and volume the Exhibition buildings abound with extraneous noises of all kinds, including the assiduous young man with the klaxon, referred to last week, and by the strange laws of coincidence these disturbing noises nearly always coincide with an important telephone conversation, so that unless one speaks from a specially sound-proof cabinet the chance of distinguishing what is said is small indeed.

Talking of wrong numbers, I have been rung up at various times in mistake for the Never-Stop Railday, the Lucullus Restaurant, Messrs. Lyons (pardonable mistake this in view of their ubiquity), the Admiralty, and the Australian Bank. I am only waiting now to receive an urgent call from the State apartments in the Government building to attend some Royal function, and my catalogue of "ineffectives" will be about complete. No wonder the exhibitors of the Strowger Director System projected by the London area report many inquiries from interested London visitors as to where the system is going to be installed first. Every inquirer evinces a fervent hope that his particular district will be the favoured one, from which one gathers that the average Londoner is not altogether enthusiastic over the existing service, good as it undoubtedly is by comparison with the provinces.

A Metro. Suggestion.

Another little grumble anent the Metropolitan Railway service between London and Wembley. I suggested last week that a platform indicator was urgently needed at Wembley Park, but if such an indicator *is* eventually installed I sincerely hope it will not be in the same category as that which misleads the weary traveller at Baker Street. This latter is of the usual luminous type, and confronts the passenger as he comes up the escalator from the Bakerloo. It refers to first and second trains out from no less than four platforms, and the issue is still worse confounded by the fact that those platforms are not indicated or identified when you arrive at the top of the stairs. There *is* a luminous indicator there, I believe, but it is seldom or never lit. As a result the infrequent passenger by this route is left guessing, or endeavouring to solve a Chinese puzzle with about three seconds to spare between trains. I have lost two fast trains through that —— indicator within seven days, hence these notes.

Another point: Why two long first-class coaches *together* in the middle of most standard trains? If you travel first and are standing at the centre of the platform you have a sporting chance, but if your ticket is of the humbler order, and you are located anywhere except at the extreme ends of the platform, you have a considerable walk or run to reach a third-class coach and to attain a "smoker" before the "right away" is something of an achievement. There has been some little lack of foresight in the make-up of these trains, and I suggest that the responsible authority does a little Metro. travelling on his own account, and tests the justice or otherwise of my criticisms.

E.D.A.

In connection with their very excellent and representative exhibits on behalf of the industry at Wembley, the E.D.A. also issue some very clear and comprehensive leaflets and associated literature giving the why and wherefore of electricity for cleaning, domestic power, fans, heating, lighting, and cooking. They also issue a clear map showing the exact location of the E.D.A. exhibit, which attracts considerable popular attention, and is admirably located at the entrance to the Palace of Engineering nearest to Wembley Park Station. There is a very capable and hard-working staff of demonstrators, who never tire of showing the harassed housewife how to offload most of her troubles on to the local electric power station. Judging by the universal interest displayed in these exhibits and demonstrations, the B.E.E. should bring considerable grist to the supply interests after the show is over if not before.

With regard to actual business done at the various stands in the Engineering Section, although some exhibitors report good results already, I incline to the opinion that the Exhibition is young yet, and that the more influential buyers will not be coming along from overseas until June or July. There are good attendances each day, but most visitors are of the sightseeing order, and not there for business as understood by the manufacturing exhibitor. That orders will come along as an ultimate result of the show there is no question, and the success of the Exhibition from the standpoint of general publicity is already well assured.

The G.E.C.

Congratulations to Mr. Hirst and his co-directors on the magnificent display which they have made in the electrical section of the Palace of Engineering. It is worthy of the company's reputation, and I can but hope that the heavy outlay which it represents will in the long run be more than repaid by the business which it will bring to them. What is more, I am confident it will. I was privileged to be present recently when the representatives of the Press were invited to view the pavilion, and can speak in terms of high praise of the excellence of the display and the shrewd ability with which the company's wide range of manufactures is shown to best advantage in the space available. Fuller details are given in another part of this issue, so I need only refer to the speeches at the luncheon, and say that I do most cordially endorse Mr. Hirst's complaint about the removal of the McKenna duties, while Mr. Railing's somewhat more optimistic outlook was based, as he said, on the proviso that we all work, and work hard, towards the trade which we are anxious to secure. As usual, great credit was due to Major Palmer, manager of the G.E.C. publicity department, for the excellent way in which the whole function was organised, and I endorse the congratulations to him on its success which were tendered.

The Public Becoming Technical.

The world is becoming more and more scientfic, and, in the broad sense, engineering the dominating force. Not only has progressive invention stimulated and eased life in many ways, but the public itself has become so involved in all the modern aids that the ordinary workaday language of the people tends more and more to make use of technical terms. The engineer no longer has a monopoly of such names as horse-power, watt, inductance and so forth. All this may be to the good or not. I think it is inevitable. After all, you cannot expect people who make such *personal* use of things like electrical appliances and motor vehicles to do so and not absorb some of the technique. So here we are with the great public, which at one time was said to be (in the mass) so ignorant and unprogressive, now slowly learning technics. I said before that all this may be good or not. I feel sure that it is not only typical, but that it ought, in a gentle way, to be encouraged. Frankness and open diplomacy is as much in keeping with the modern spirit as the inevitable absorption of technical matter by the public.

For a long time I have considered that the electrical industry has been remiss in not nursing the public in this particular way. I see that Councillor Stanworth, of Blackburn, believes that electrical consumption would be encouraged if, in all publicity schemes, less technical terms were used. The report goes on to mention that "he stated last week that in a large number of pamphlets which he had examined whilst on visits to other towns, no attempt was made to make clear what electricity was, but the writers assumed that everyone knew what a kilowatt was, and so forth. The Blackburn Committee proposed to issue a statement which, he hoped, non-users of electrical current would easily understand and appreciate." Councillor Stanworth is quite right in all he says, and the step proposed by the Blackburn Committee is an admirable one. But, rather than assume that the consumer is utterly unlearned in electrical terms, it would be much better if he were gently to be coached. I think (and I say this after some experience in the matter) that the use of word-pictures and analogies which leave the "student" *in actual ignorance* does not, in the long run, help. Far better to get a few essential terms understood to a certain extent.

Coaching Consumers.

When one considers how much wireless jargon has come into the everyday conversation of so many people, I see no reason against coaching, in an equally subtle way, all electrical consumers, domestic and otherwise. The real electrical age will yet be upon us, and those in the industry, as well as the public, might as well be prepared. Of course, the schools can help, and should look after the next generation; meantime, there are the grown-ups to tackle. If only we used no other term but the handy and universal "unit," or, perhaps, have meters calibrated in pence or shillings!

" Where Ignorance is Bliss——."

It is curious how, even in electrical circles, one comes across examples of technical ignorance; really, it is not so curious if one remembers that there are many people employed upon electrical jobs whose work may be incidental or non-electrical. For instance, there was a time-switch and clock expert of my acquaintance who one day pathetically asked: "What *are* these *amfers* you're always talking about?" And then there is the old story of the man who (referring to the same term "amperes") spoke of *hampers* of electricity. Only the other day a man who has been employed in electrical surroundings for many years stopped me to ask a few questions about the one-valve set he was making. He first of all wanted to know *what a volt was*, and then seemed very uncertain as to whether the anode battery was an A.C. or H.T. one. To him one sounded like the other! Eventually he decided to get ten flashlamp batteries as a *start* towards his valve set, *and see how he got on!* During the war there was actually a man who managed to do shift work in a small sub-station (his duties included synchronising-in the "rotary"), spending nearly two years on his job utterly in the dark as to what the indications of the switchboard instruments really meant. His bluff and luck held good all that time, and he was aided by an imitative faculty which held him in good stead. I need hardly say that he came a "cropper" at last—and it was a pretty serious one for the company. *He*, however, promptly found a job driving a cart!

Lighting Textile Mills.

The papers on this subject presented at the last meeting of the Illuminating Engineering Society dealt only with gas lighting and daylight illumination, but I understand that electric lighting is reserved for future treatment. However, there were, in the papers by Mr. Oughton and Mr. Waldram, points of general interest, irrespective of the illuminant. I cannot help feeling that the conditions of illumination necessary for these complex and intricate textile processes have not yet been worked out with the same precision as in the case of ordinary factories. In low rooms occupied by bulky machinery it is difficult to get good illumination without troublesome shadows. The direction from which the light comes is very important in many cases, and the material is often very dark in hue, so that an exceptionally high illumination is required.

Daylight Illumination.

In regard to daylight illumination, ideals as regards window space are limited by considerations other than illumination. At all costs the temperature and humidity necessary to keep material in good condition and prevent snapping of threads must be maintained, and in some cases overhead skylights are impracticable. Further, the influence of these conditions on the health of the workers has to be considered. In Mr. Waldram's paper the varied lighting requirements of different processes were clearly revealed. In the vicinity of London there are no textile works of importance. The discussion merely served to give a glimpse of the complexity of the problem and the need for research, in which the co-operation of the great textile organisations in the north should be invited.

ELEKTRON.

Tenders Accepted.—The L.C.C. has renewed the contract with the Siemens and English Electric Lamp Co., Ltd., for the supply of the whole of their requirements in electric incandescent lamps for a further period of twelve months.

Quotations Wanted.—The City of Melbourne are inviting tenders for the supply and delivery at the site in Melbourne, free of all charges, of ornamental street lighting units as follows:—100 single light units complete with Goliath or Mogul sockets; 185 single light units complete with standard Edison screw sockets; 10 two-light units complete with standard Edison screw sockets.——The Municipal Council of Johannesburg invite tenders for cut-outs, fuses, insulating tape, etc.——The Taihape, N.Z., Borough Council invite tenders for the supply, delivery and erection of one turbo-generator set, complete with all accessories, one oil pressure governor for an existing water turbine, and one automatic weir.——The Newcastle, N.S.W., City Council's Electricity Supply Dept. invite tenders for high-tension submarine cables and accessories.——The Electricity Dept. of the Sydney, N.S.W., Municipal Council invite tenders for 5,000 volt automatic induction voltage regulators.—Specifications, etc., at the D.O.T. (Room 52), 35, Old Queen Street, S.W.1.

THE G.E.C. AT WEMBLEY.

The correct scale for a really adequate exhibit of G.E.C. products would be an immense tract of country, with cities and villages, railways, tramways, and other transport services; mines, quarries, factories, mills, and every other form of industrial enterprise; farms and market gardens, docks, waterworks, and other public utilities; telegraphs, telephones, and wireless broadcasting; in fact, every feature of modern life. Under such conditions and only under such conditions, could the G.E.C. present the full range of its manufactures—the power station plant which generates the current, the cables which carry it, the switchgear and converters which control and adapt it, the motors which drive everything from a huge rolling mill down to a sewing machine, the lamps and the heating and cooking appliances which reveal the domestic uses of electricity; the equipment of switchboards, cables, relays, and valves by which communication is maintained; and the innumerable instruments, accessories and fittings involved in the general adaptation of electrical energy to the use and convenience of man.

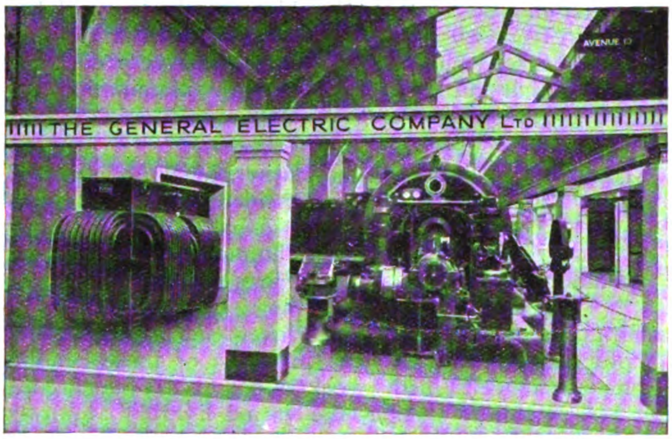


FIG. 1.—SECTION OF THE G.E.C. PAVILION DEVOTED TO THE GENERATION OF ELECTRICITY.

It was therefore a formidable problem to arrange, within the space of a single stand, an exhibit worthy of this endless catalogue of manufactures. The G.E.C. has endeavoured to solve it by skilfully arranging to include in the space available a representative display of every one of its typical productions.

In the Power House Section are shown the complete electrical equipment of a central station, typical of many similar equipments supplied to the principal power stations at home and overseas, in all sizes up to 25,000 k.v.a.

Alternating current is received from the Exhibition supply at 3,300 volts, and after being transformed down passes to a rotary converter, which delivers direct current on a three-wire system at 440 volts to the G.E.C. stand, and also to other stands in the Palace of Engineering. An additional small transformer is installed to give an alternating current supply at 440 volts where required, while current is supplied to the cinematograph equipment in the Cinema Hall on the first floor, through a motor generator driven off the 440 volt D.C. system.

The various circuits are controlled by a main switchboard, comprising three truck type cubicles for the A.C. circuits and panels for the D.C. side. G.E.C. engine room telegraph apparatus is also installed.

In the Goods Handling Yard section are shown various G.E.C. appliances for handling materials, and in addition a variety of electrically-driven machines suitable for operation in exposed situations.

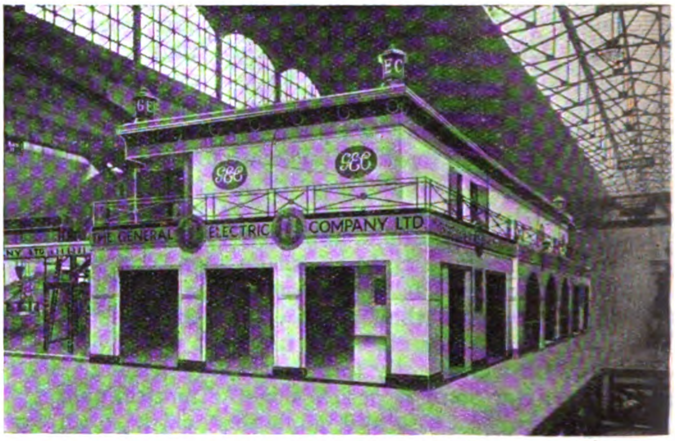


FIG. 2.—GENERAL VIEW OF THE G.E.C. PAVILION.

A Fraser and Chambers' belt conveyor is in constant operation, and the remarkable achievements of the modern lifting magnet are impressively shown by a "Witton-Kramer" lifting magnet and hoist in operation, lifting scrap metal and depositing it in a pit.

Another exhibit in constant operation is an exact model (one-eighth size) of a Fraser and Chalmers winding engine.

The colliery portion of the yard includes a typical "Witton" flame-proof colliery motor, fitted with the necessary control gear, and adjacent to it is a charging rack for the "Kingsway" miners' safety electric lamp. Both the lamp and the charging equipment comply fully with the rigorous official regulations and present many special features of safety and economy. A complete colliery signalling rack in operation, and colliery bells, telephones, relays, and various accessories, are also shown.

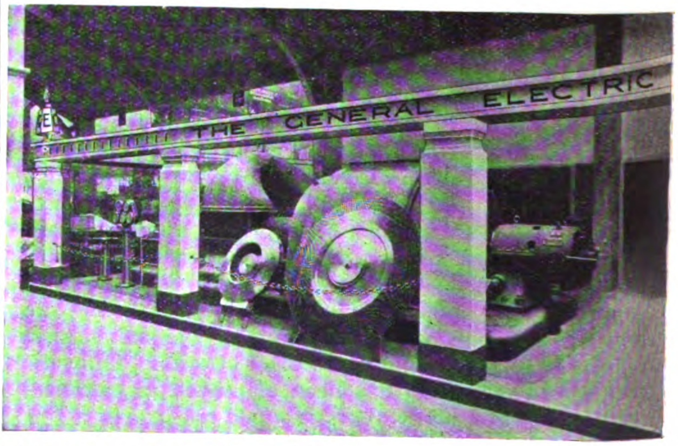


FIG. 3.—5,000 KW. G.E.C.—FRASER AND CHALMERS TURBO ALTERNATOR.

Steel works electrification—another field in which the G.E.C. specialises with conspicuous success—is indicated by a live roll motor with specially-designed control gear, while one of the most interesting exhibits in the same section is the 45,000-volt three-phase outdoor type switch, shown connected by overhead lines to Isenthal type protective gear.

The display of products suitable for outdoor use is completed by a new type of outdoor lighting fitting known as the "Wembley" lantern, which has already been described and illustrated in our columns.

The contents of the Industrial Section are selected and arranged to demonstrate how G.E.C. products cover every phase of electrical application for all industrial purposes, and include a replica of a modern liner's cabin; on the outside walls of which are displayed various types of electrical fittings as used on board ship.

In similar manner the activities of the G.E.C. in regard to railway electrification are represented by a section of an electric railway car equipped with G.E.C. fittings, fans, etc., together with a G.E.C. traction motor, and a display of G.E.C. railway signalling apparatus, including a full-size working example of the Hall colour light signal.

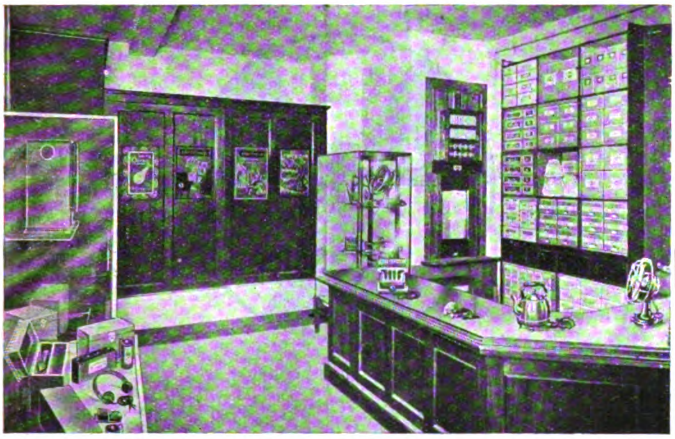


FIG. 4.—THE INTERIOR OF THE MODEL ELECTRIC SHOP.

"Witton - Kramer" electrically - driven tools, including portable drills and grinders, are shown in operation, whilst along an adjacent wall are exhibited factory bells and telephones, ironclad switchgear, and "Pirelli-General" cable accessories. Showcases also are set aside for the display of industrial electric heating appliances, carbons, batteries, etc., and the lighting installation is carried out with various types of industrial fittings, so arranged that the effect of increasing intensities of illumination can be demonstrated.

THE ELECTRIC SHOP.

The Electric Shop, which occupies a corner of the ground floor to the right of the main entrance, serves a triple purpose. It constitutes an exhibit of the G.E.C. products which form the appropriate stock—complete in every detail—for an electrical retailer's establishment, and secondly, it shows the arrangement which, as a result of long study and experience, is suggested as the most effective means of displaying and stocking electrical goods, while in the third place, the lighting arrangements, both of the interior and the windows, afford striking examples of the most modern practice in shop illumination. They will appeal not only to the electrical but to every class of retailer. The dressing of the windows will be changed periodically during the exhibition so as to illustrate various methods of display and the appropriate illumination, incorporating special colour effects.

It is realised that the Shop has more windows than the average shop would ordinarily possess, and advantage is taken of this to show alternative methods of window dressing, and to display permanently in one window a G.E.C. country house lighting plant.

Other well-arranged sections include an electric kitchen, as well as a sitting room and bathroom. There is also an automatic telephone exchange included in the exhibits in the Upper Hall. This is of special interest in view of the extensive Post Office programme for the replacement of manually-operated exchanges by automatic equipments. The G.E.C. has been successful in obtaining a portion of this contract.

Altogether, the pavilion and the display generally is well worthy of the reputation which the G.E.C. holds in all parts of the globe.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.

ANSWERS: A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 180.

Can any reader inform me how I can obtain the value of the inherent reactance of an alternating current generator? I have no particular make of machine in mind, but current limiting reactances interest me and I cannot get any technical details.—"H. B. HURRY."

QUESTION NO. 181.

I wish to make up a condenser for a home-made wireless set with mica and tin foil. Can any reader give me constructional details, *i.e.*, thickness of mica, quantity of tin foil, and precautions to be taken?—"E. J. MORTON."

(Replies to Questions Nos. 180 and 181 must be received not later than May 31, 1924.)

Answers to Questions.

QUESTION NO. 178.

When working a cinema projector on 200 volts 50 cycles, with a three-bladed shutter, an intermittent light was produced on the screen. By using a single-bladed shutter this was eliminated. Can any reader explain this to me?—"OPERATOR."

NOTE.—Owing to an error, the above question was inserted in our Question and Answers column after the closing date had been announced. The result was that replies were received to this question. We have selected the best of these replies and have awarded a prize of 10s. to Mr. G. E. Moore, 52, Sidney Grove, Newcastle-on-Tyne. The reply is as follows:—

REPLY TO QUESTION NO. 178.

The question put by "Operator" is an extremely interesting one, for it really concerns the very basis of kinematography and, incidentally, another curious science called "stroboscopy." These depend upon the fact that the human eye, which so many people think of as an extremely alert and quick member, is actually nothing of the sort; in addition, it has a sort of time-lag, for if you impress a brief picture upon it, that picture persists for quite a time. As a result, all sorts of tricks can be played upon the human eye.

I propose to answer "Operator" in a rather roundabout way, and even when I do get to the point he may not consider it throughgoing enough. Unfortunately, he does not really give all the vital facts.

Well, now, in his operating-box he uses in his projector an arc running on a 50-volt supply. This means that his arc lamp gives 100 blinks per second—a state of things which can be shown in the way given by Fig. 1. Here it will be seen that maximum illumination is reached twice per cycle. Actually the blinks are not separate so to speak, for, as the fig. shows, owing to the heat lag of the carbons zero illumination is never reached.

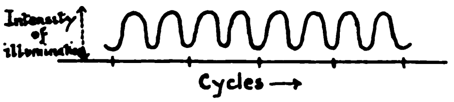


FIG. 1.

Now, if I could be quick enough and put my cap in front of the arc-lamp exactly at those times when maximum brilliancy is reached, there would not be much useful light left. By using a rotating shutter at the proper speed this can be done. The blink effect can be shown in another way by passing the hand very rapidly through the 50-volt illumination, when the effect will be as though one had innumerable fingers. I have in my file on "stroboscopy" a letter to *Electrician* of October 26, 1900, in which a John Lester writes describing a similar effect which *he* noticed whilst swinging his walking-stick in an arc-lighted street.

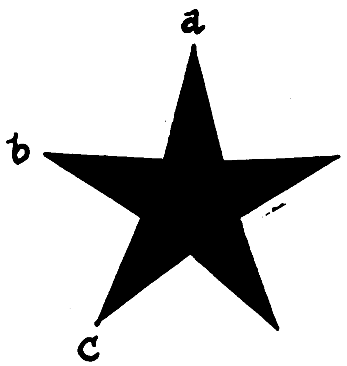


FIG. 2.

If "Operator" makes a 5-pointed star like that in Fig. 2 and rotates it (say, on his shutter shaft) at about 20 times per second, he can rotate it at such a speed that the blurred figure of the 5-pointed star *can be seen.* The figure is blurred because, as I said before, the 50-volt arc does not give *clear* blinks. However, if in place of the arc-lamp he uses an "Osglim" or *similar* lamp, he will get a less blurred picture of the star.

This is remarkable, and it is because point *a* (say) moves to the place left by point *b between two blinks*, point *b*, of course, having shifted to *c*'s position, and so on. And so the eye appears to see a stationary 5-pointed star.

Coupled with this effect is another. If the star revolves at a speed slightly *less* than above, the star will appear to move *backwards* slowly; if its speed is rather more, it will seem to revolve *forwards* at a slow speed. This is because, in between blinks, a point either just doesn't reach the point-position ahead or overshoots it.

Now for "Operator's" problem. In his projector is an arc-lamp with the 100 blinks or light-pulses per second. Intercepting that light is a 3-bladed shutter. For the purpose of the argument I am going to assume that the three blades and the three spaces are equal. As a rule, this is not so, for one blade is made fairly wide, and whilst it cuts off the light to the screen a picture on the film is brought into place, and *then* thrown on the screen, being intercepted twice by the smaller blades. However, we can assume a shutter like that shown in Fig. 3. It will serve to keep the explanation fairly simple.

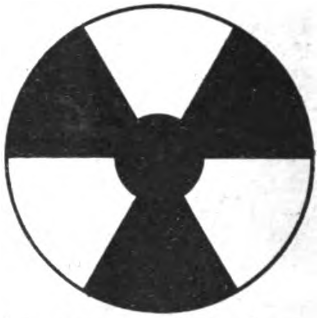


FIG. 3.

As the shutter goes round at about 16 times per second (for that number of *separate pictures* are thrown on the screen during that time), each blade and each space represents about 1-96th second. Speed-up a little and this value becomes 1-100th second. Now round about each hundredth-second there is a pulse or blink of light, and if "Operator" looks again at Fig. 1 I think he will realise that queer things can happen to his illumination. For instance, it might be possible for the blades to wipe out alternate pulses altogether. This, however would not become apparent to the spectator's eye.

But suppose the shutter speed be brought up to a higher value still, as could readily occur if "Operator's" manager loaded on to him the thousands of feet of film which, forsooth, must be got through in one short show. It should now be possible for a blade to intercept the beam every time maximum illumination is given by the arc. Down would go screen brilliancy. If there is an in-between speed one might get a rising and falling value of screen light.

Without, therefore, going into the *precise* details of "Operator's" predicament (these are not really provided), enough has been said to show how possible it is for trouble to be caused under such circumstances.

"Operator" substituted a single-bladed shutter and the difficulty vanished. Of course! For now, although he could cut off a few individual blinks of light from the arc, most of them would get through to the screen and the general effect would be all right.—"G. E. M."

ELECTRIC DRIVING OF A MODERN FACTORY.*

BY F. W. SMITH, N.A.S.E.

(Continued from page 261.)

WITTON-JAMES SYSTEM.—TWO-MOTOR.

This equipment for the driving of rotary web presses is of the two-motor type, the power plant consisting of an auxiliary motor driving through worm reduction gear, free-wheel coupling and the main motor shaft for the purpose of inching the press around and driving same at dead slow speeds for make-ready purposes, the main motor automatically taking up the load as speed is increased, leaving the auxiliary plant shut down from about quarter speed.

The outfits are standardised for both direct and alternating current circuits, single-, two- and three-phase, and the standard form of assembly of the power plant is on combination cast-iron bedplate with the auxiliary plant mounted at the non-drive end of the main motor; but where requirements of space and general press conditions demand it, other forms of assembly are arranged:

(*a*) The complete plant on combination base under the press.

(*b*) The main motor outside the press on one side, and the auxiliary plant underneath the press with shaft extension through coupling to the main motor; or

(*c*) The main motor outside the press on the one side and the auxiliary plant on the other—in fact, the plant lends itself to almost universal requirements of assembly.

The equipments are graded in a number of sizes from 20 to 150 h.p. for use either singly, two or three, or any reasonable number in parallel, three being the greatest number yet so called for; or four in pairs parallel.

The makers support the worm drive in preference to any other system, and contend that this very positive and mechanical means ensures the most satisfactory results under any conditions of load and press combination.

The switch-control apparatus consist of marble panels on angle-iron frame with main and auxiliary contactors, circuit-breakers, overload trips, auxiliary motor reversing switch, and multiple contact faceplate type controller, by means of which the power plant may be literally "inched" around, run at a number of dead slow speeds for make-ready purposes, and at any of 70 steps of acceleration and deceleration for printing purposes up or down as required.

The controller is worm operated, driven by a slow-speed reversible motor through silent chain gear.

The actual control is purely automatic in single or multiple combination from one to twelve push-button boxes being provided on the press, each having "inch," "speed up," "slow down," "stop," and "on-off" safe switches.

The number of five-way boxes is a matter of selection, and in combination with them the firm provide, where required, any number of three-, two-, or one-way box stations, these consisting respectively of:—

(*a*) "Inch," "Stop," "Safe."

(*b*) "Stop," "Safe," or

(*c*) "Stop" only buttons.

An emergency push-button box is provided which prevents delay in the event of a defect or damage in the normal control circuit, this box being instantly brought into action by means of a change-over switch should such occur.

In the direct-current equipments an electro-dynamic brake is automatically applied on operation of the "stop" button, and in the case of alternating-current outfits electro-magnetic brakes bearing on a rim carried on the periphery of the flywheel coupling.

Speed variation on direct-current circuits is obtained by series armature resistance to one-third or half-speed, and shunt regulation to maximum. On alternating-current circuits by resistance in the rotor of the slip-ring type machine, and pole shifting by means of the brushes in the variable speed commutator type motor. The mechanical means for this purpose being actuated by the controller motor interlocked with the latter.

(To be continued.)

---

* Lecture delivered before the N.A.S.E.

Reviews of Books, &c.

[Books noticed in this column will be sent from **ELECTRICITY** ***Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]***

ELECTRIC MOTORS: DIRECT CURRENT. By H. M. Hobart. Third edition. 412 pp., 374 figs. (Pitman, 15s. net.)—In its third edition this well-known treatise has been revised throughout and largely rewritten, but the specifications of a number of machines of older design are retained because these satisfactorily illustrate the details of procedure in preparing designs. Though this volume is mainly about direct current motors, it must be understood that there are many problems and methods common to the design of both direct and alternating current machines, so that the complete work must be studied; any attempt completely to separate the treatment of D.C. and A.C. motors would inevitably lead to much repetition. For example, improvement in methods of measuring the power developed are largely common to all motors, as also are the laws of the magnetic and conducting circuits and of the heating and cooling of the machine. After dealing with the classification of electric motors and giving a general discussion on direct current machines, the author presents, in Chapter III, a valuable collection of general data for motor designing. Commutation, the effects of various types of armature windings and other factors influencing commutation are next considered, after which the design of the commutator itself is discussed. Chapters on compound-wound, series and shunt motors, and on the efficiency of electric motors, are followed by others on insulation and space factor and on standard dielectric tests for motors. There then follows a series of chapters with examples of designs for various types of motors by different manufacturers. It is here, of course, that the main value of the book lies, and any student who works conscientiously through these designs will know all that can be taught by a book on this subject. The concluding chapters in the volume relate to load tests on electric motors, heating standards for these machines, and excerpts from the standardisation rules of various countries concerning service requirements on electric motors. We doubt not that the new edition of this work will be as popular as its predecessors, and we look forward to the appearance of the second volume at an early date.

Various Items.

Agents Wanted.—Leyfair and Co., the fuse and switchgear specialists, of Docwra's Yard, King Henry's Walk, N.1, want good provincial agents. See their advertisement.——The makers of the Hogarth wireless sets want good, live agents. See small advts. page.

"**Graphical Calculations of Overhead Electric Power Transmission Lines.**"—This is the title of a paper by Mr. W. T. Taylor, M.I.C.E., which has just been reprinted by the Inst. of Civil Engineers. It forms a neat pamphlet of twelve pages and contains much matter of direct interest to all who are in any way associated with the overhead transmission of power.

"**Wembleygrams.**"—This is the title given by Messrs. Johnson and Phillips to a neat little souvenir which they are presenting to visitors to their stand at Wembley, at the same time that they are invited to add their names to a list of visitors in a book which is in a prominent position at the J. and P. Pavilion. It contains an ample supply of ruled paper for notes as well as text dealing with the firm's numerous specialities, and should thus prove of double use to all who receive it.

Useful Maps.—Four very useful maps have just been published by Messrs. Geo. D. Atkin and Co., the well-known stockbrokers of 1, Drapers' Gardens, London, E.C.2, for the benefit of their large clientele among shareholders in the leading electric light and power undertakings. The areas represented are: The Lancashire E.P. Co., Ltd., the Midland Counties E.S. Co., Ltd., the Shropshire, Worcestershire and Staffordshire E.P. Co., Ltd., and the Newcastle-upon-Tyne E.S. Co., Ltd., with its associated companies. They have been well printed in colour by Messrs. Stanford, and mounted on canvas in book form, so they are certain to be appreciated by Messrs. Atkin's clients.

Complimentary Dinner to Colonel R. E. B. Crompton, C.B.—Colonel Crompton's old associates and pupils are entertaining him to dinner at the Royal Automobile Club in London on Saturday, May 31, the occasion being the anniversary of Colonel Crompton's 80th birthday. As far as practicable, advice of this event has been sent to those whose addresses are available, but, in the event of any names having been omitted who would in the ordinary course care to partake in the function, they are requested to communicate with the hon. sec., Mr. E. J. Fox, the Stanton Ironworks Co., Ltd., near Nottingham. Some 50 applications have already been received from those desiring to be present.

Obituary.—We regret very sincerely to note the death on the 7th inst. of Mr. Francis Jacob, at the age of 71 years. Mr. Jacob was a very prominent figure in the world of submarine telegraphy and telephony, having joined the firm of Messrs. Siemens Bros. in 1873, and since that date he was almost continuously engaged in the design and laying of submarine cables, including the following: Brazilian cable for the Platino-Brazileira Telegraph Co., 1873-4; Atlantic cable for Cie. Française du Telegraphe de Paris à New York, 1879; Atlantic cables for the Western Union Telegraph Co., 1881 and 1882; Atlantic cables for the Commercial Cable Co. in 1884, 1894, and 1900, etc. He was the inventor of the multiple twinning system for cables which is now universally adopted, and also of numerous testing devices and apparatus, including the Jacob's relay for submarine telegraphy. He was one of the oldest members of the Physical Society, and was regarded as perhaps the greatest authority on cables. He contributed the article on this subject in the *Encyclopædia Britannica.* For many years he was the chief electrician at Messrs. Siemens Bros. Woolwich works, and in 1914 was appointed the works general manager. He retired from the latter position in June, 1921, having completed nearly fifty years' service with the company.

FOR
TECHNICAL BOOKS
of all descriptions
send enquiries to
S. RENTELL & Co., Ltd.,
36, Maiden Lane, London, W.C.2.
'Phone Gerrard 2460 and
ask for our catalogues.
30 YEARS' EXPERIENCE

Kelvin Centenary.—On the occasion of the celebrations in connection with the centenary of the birth of Lord Kelvin, which will be held at Glasgow University on Commemoration Day, June 25, Dr. Alexander Russell, F.R.S., the president of the Institution of Electrical Engineers, will give the Memorial Oration. Lord Kelvin was three times president of the Institution of Electrical Engineers, and Dr. Russell is an old pupil of his.

Denmark.—The librarian of the Industriforening (Industrial Association), Vesterbrogade 1, Copenhagen, is making a library of catalogues of manufactured goods, and would be very pleased to receive those issued by United Kingdom firms who are anxious to increase their business in engineering materials, etc. The Department of Overseas Trade suggest that these should be sent as they may help to increase business between Denmark and Great Britain.

Quotations Wanted.—The State Electricity Supply Works at Montevideo invite tenders for the supply of six three-phase 6,000/220 volt transformers.——The Direction de L'Outillage du Port, Antwerp, are inviting tenders for the supply, delivery and erection of 15 electrically operated Portal cranes, each of 3 metric tons capacity, on the No. 3 dock of the "Quai du Nord."—Specifications, etc., at the D.O.T. (Room 52), 35, Old Queen Street, S.W.1.

Annual Dinner of the J.I.E.—The fortieth anniversary of the Junior Institution of Engineers was celebrated at a dinner at the Cafe Monico on Tuesday, May 6. Sir J. Fortescue Flannery, Bart., president of the Institution, was in the chair. There were also present Sir T. O. Callender, as a guest of the president, and Sir Archibald Denny and Capt. H. Riall Sankey, past-presidents. Sir Archibald Denny proposed the toast of "The Institution," and emphasised the value of taking part in all the Institution's activities, especially the visits, while Mr. W. J. Tennant proposed "The Marine Engineers," and said that London had ceased to be the headquarters of the shipbuilding industry, but would nevertheless always have something to say in marine engineering. In his reply, Sir Fortescue Flannery said that he would impress on men who desired to attain success that they must have a speciality, and claimed that there was a future for the engineering profession, greater even than the past, which could be looked back upon with such pride.

Trade Notes.

Pamphlet P. 186, from the **British Insulated and Helsby Cables, Ltd.**, of Prescot, deals with the Prescot jointing materials and accessories, and in its eight pages contains much matter of interest to all distribution engineers and contractors who are in any way associated with cable laying and jointing generally.

From the **Machine Tools Trades Association**, of 70, Victoria Street, London, S.W.1, we have received a magnificent quarto catalogue of nearly 400 pages illustrating the British machine tools, woodworking machinery, and engineers' small tools manufactured by members of this great English trade organisation. It has been published wtih a view to increasing the sale of British machine tools at home and abroad, and it is to be hoped that the results will more than justify the expense which has been incurred. Under any circumstances it is a magnificent advert. of English manufacturing skill, and is certain to bring business to all those who are associated with the enterprise. The official published price is 10s. 6d. net.

A neat folder dealing with the White Mazda Lamp has been issued by the **B.T.-H. Co., Ltd.**, of Mazda House, Upper Thames Street, London, E.C.4. It gives illustrations, details, and prices of this very useful type of lamp, and should therefore be of direct interest to all contractors and dealers, who are advised to apply for copies of the folder without delay.

A well-illustrated 20 pp. catalogue of various types of electric fans and accessories has been issued by the **Ediswan Electric Co., Ltd.**, and should prove of direct interest to all electrical contractors and to dealers in electrical apparatus generally.

An attractive poster, entitled "Keep Cool," has been issued by the **B.T.H. Co.** as an advertisement of their electric fans, and should be of business value to all dealers in these useful accessories, as well as to electrical engineers and contractors generally. Copies may be obtained on application to the company at 77, Upper Thames Street, London, E.C.4.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

MAY 30, 1924.

CONTENTS.

	PAGE
About this Power-Factor	277
The Largest Sign in the World	278
Conferences of Engineering Societies at Wembley	279
Visit of Overseas Delegates	279
" Lopulco " Pulverised Fuel	280
Electricity Supply Workers	280
A Tool of Quality	280
Current Topics	283
Correspondence	284
Hoarding Lighting	285
Electric Driving of a Modern Factory	285
The Liberty Crystal Radio Receiver	286
New Marconi Pamphlets	287
Various Items	288

ABOUT THIS POWER-FACTOR.

By G. E. Moore, A.M.I.E.E.

I.

[*There are many readers to whom the much-discussed " Power-Factor " of alternating current circuits is a great mystery. Some of these readers will have had experience of both A.C. and D.C., but have not gone deeply into the technical side; others will only have touched direct current work; while a few with commercial standing must regard all the conditions more or less as chapters in a closed book. In this and the two articles which follow the writer gives some simple and interesting facts about power-factor which should appeal to all these readers.*]

By Way of Introduction.

My mind travels back to the time when I attended an evening technical college—that pre-war time which now seems to us so remote and restful. Our class had just started on alternating currents, and the lecturer had somehow sensed that we were feeling very dubious indeed about this particular brand of electricity. For, you know, we were a rather mixed crowd. One or two isolated fellows had actually had experience of A.C.; several others had been through the previous session, but were not passed out; while to most of us both the theory and the practice of alternating current engineering were entirely new. Also, all of us had arrived at the college after a day's work, and were not (as many of you will understand too well) in quite " the fettle " for complex A.C. things like sine waves and vectors.

Well, to return to the lecturer. He suddenly realised that the start-off on A.C. was not quite so successful as it might have been, and for nearly the whole of that evening's lecture he tried desperately to convince us that an alternating current was no more difficult to understand than a direct or continuous current. He did *not* convince us, though he managed to allay some of our fears. I am afraid that all the time his blackboard was standing up as a witness for the prosecution, with damning evidence in the shape of vectorial diagrams and formulæ! Having spent nearly all his eloquence in this wise, the lecturer, to our great dismay (and I cannot forbear to smile when I remember this), returned with gusto to technical matters and launched into a discussion of power-factor. Recall, if you please, the sort of crowd he was addressing!

And now forgive me, if you will, while I step into the lecturer's place, and forgive me, too, if I point out that I know I am addressing a rather mixed audience. Will those of you who want a highly technical and academic dissertation move on into a more suitable environment? Thank you! I feel a bit safer now, especially as you are much more favourably situated than *we* were in our class. I mean that if you become " fed-up " your remedy is simple—but in our case there was only disguised slumber to fall back upon, and this was more than paid for by the agonising attempts to remain awake.

To Get to Business.

At first sight the term " power-factor " does not seem to mean much. This is because the root of the matter concerns a peculiarity of alternating currents which is not quite explained by the term itself. The peculiarity is a condition which brings in another queer term, " phase-angle," a term which, in a sense, is a misnomer and at first sight more meaningless than " power-factor." The whole thing boils down to a question of *time*, and if this is remembered many problems will become simpler to the novice and even to the expert.

How does time come into the matter? In this way: Under alternating current conditions the application of *pressure* is not at once followed by *current*. The current may be said to *lag*, or hang back, and it does so because in the circuit there is something (generally " inductance ") which prevents it. In other words, you can truly say that the current is SLOW. And, stranger still, you can have a circuit, containing a " condenser," which actually makes the current *lead* the pressure—that is, makes it FAST. So here we have those two familiar words *lag* and *lead*, or *slow* and *fast* current.

Now, in ordinary continuous-current work you don't meet with this sort of condition. There are, however, instances in which the conditions which so upset the current in A.C. work can also misbehave with direct current.

" Slow " and " Fast " Current with D.C.

Take the case of a big inductance—say, the rotor of an alternator, which is a great mass of iron plus many turns of wire. If you connect a battery to this the current takes so long to " build-up " to its maximum value that you can sit down and smoke a cigarette. Here, you see, the current is obviously slow. Now consider the case of a long transmission line or submarine cable which acts as a condenser and can swallow, as it were, a large quantity of electricity. When pressure is first applied there is a tremendous rush of current to " charge-up " the line or cable, and the potential of the condenser is small; but the current falls as charging-up is effected and at the same time the pressure rises. Here there is an opposite state of affairs, for whereas in the inductance the current was slow, here in the condenser it is fast.

These, however, are exceptional cases in direct-current work and not often met with by those whose experience is bounded by the latter. But they are worth mentioning, and for this reason in particular: whereas in these exceptional D.C. cases the current is fast or slow at first and then settles down, under alternating current conditions, with the pressure *alternating all the time*, the current *never* settles down and is forced to remain fast or slow, or, as we say, in A.C. practice, leading or lagging. (What actually happens will be considered later.)

WHAT HAPPENS WITH "SLOW" OR "FAST" CURRENT ON A.C.

The result of this under alternating-current conditions is rather upsetting, for whereas with D.C. you simply get the power in watts by multiplying volts by amperes, here, with A.C., this does not always follow. If the current acts at the same moment as the applied pressure (no time difference at all) the A.C. watts *do* equal volts × amps.; but if there *is* a time difference the actual watts are less than volts × amps. It is as though two men are each going to give a *knock* to something, and instead of both knocking at the same moment each puts forth his effort at a different instant.

Now under working conditions the actual power given is what tells when work is to be done, and so your (volts × amps.) must be qualified by a factor which gives such effective power. *This factor is called the "power-factor."* When the current is neither fast nor slow, neither leading nor lagging, the factor is 1.0 and *unity power-factor* is said to exist. But generally under industrial conditions there *is* a power-factor, and almost always it is of a lagging nature; whether lagging or leading, however, its value is less than one. Naturally this is so, as the (volts × amps.) unqualified gives too high a value.

POWER-FACTOR VALUE AND TERMS.

The power-factor, then, is quite simply arrived at by dividing the *true* power by the *apparent* power, or, in other words, the watts by (volts × amps.). As a rule, the power-factor is seen attached to the (volts × amps.) expression. In connection with power-factor the term which I have mentioned before—"phase angle"—often appears; for our present purpose it need not be bothered about, and in passing, one can just hint that it is our friend the *time interval* expressed in a form convenient for calculations and diagrams. The terms "in phase" and "out of phase" simply indicate whether the pressure and current are *in line* with each other or not; and the same terms are often applied considering, say, two generators. And so in this respect you often hear the term "synchronising," which simply means *getting into line with each other.*

Well, I think that this consideration of power-factor as being caused by a mere time difference will make an understanding of the term and the condition much clearer. As I have said, the basis of the whole thing is *time*, and although in practice calculations and so on rarely bring time in as a factor, it often is useful to remember what is *actually happening*. I'm certain that the newcomer to alternating current conditions ought to see things in that way, and just as it does the expert no harm to recollect what is really transpiring in a circuit, so is it necessary for the beginner to fix in his mind a definite, simple idea. Vectorial representation, the mathematics and the rest should follow. Most lecturers and writers of technical books seem to spend little or no time in trying to stimulate the student's imagination, but forthwith sling at him with the least compunction in the world all those formidable sine wave diagrams and other abstruse things. No doubt they went through the same experience and never had their own imaginations stimulated.

Next week I hope to carry this chat on power-factor a little further, and have a look at conditions and difficulties met with in practice.

(To be continued.)

THE LARGEST SIGN IN THE WORLD.

The sign described in this article is believed to be the largest illuminated advertisement in the world. It is 512 ft. long and 40 ft. high, and consists of lettering painted on the side of one of the several works of Messrs. Herbert Morris, Ltd., Loughborough. Twenty-six B.T.-H. floodlight projectors are used to light it, and they are arranged in a single line 224 ft. away from the sign and parallel to it, the distance between the two end projectors being 728 ft. As will be seen from Fig. 3, the projectors are mounted on tripods placed in an open field, and the current is supplied from mains carried on wooden posts. Some

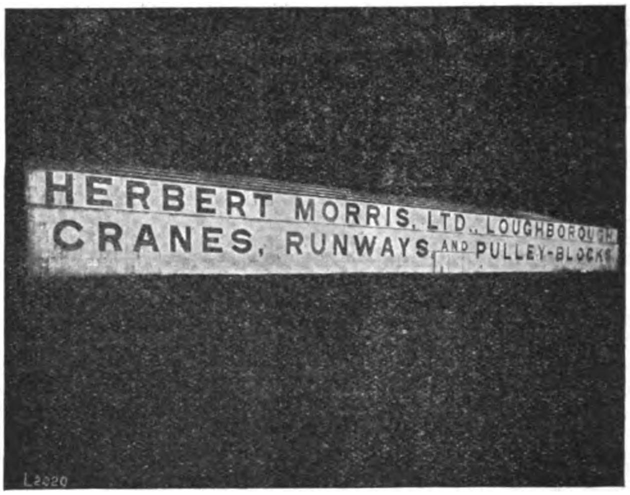

HERBERT MORRIS, LTD., LOUGHBOROUGH
CRANES, RUNWAYS AND PULLEY-BLOCKS
L2020

FIG. 1.—THE LARGEST ILLUMINATED SIGN IN THE WORLD. LIGHTED BY MEANS OF B.T.-H. FLOODLIGHT PROJECTORS FITTED WITH MAZDA LAMPS.

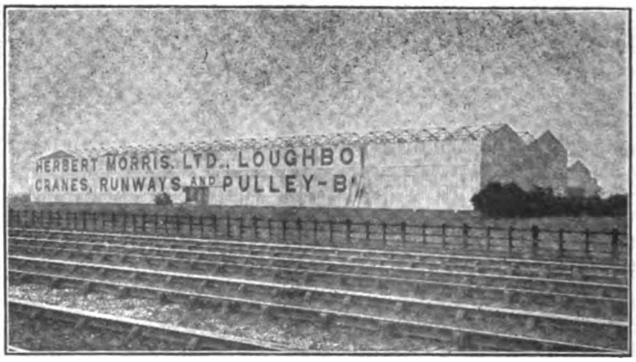


FIG. 2.—A DAYLIGHT VIEW OF THE SIGN DURING CONSTRUCTION. IT MEASURES 512 FT. LONG BY 40 FT. HIGH.

difficulty was experienced in designing the installation owing to the fact that the sign is painted on a corrugated surface, thus rendering it necessary to arrange all the projectors obliquely to the sign itself. The beams strike the sign at an angle of 60 degrees, half the projectors pointing towards the right, and the other half towards the left, the crossing beams forming a series of diamond-shaped areas. The angle of incidence is in each case either 60 degrees or 120 degrees, according to the side from which the angle is measured. By this means the light rays fall perpendicularly upon the sides of the corrugations.

Each projector is thoroughly waterproof and is fitted with a 500-watt Mazda projector type gas-filled lamp, with a plain parabolic reflector and clear glass lens.

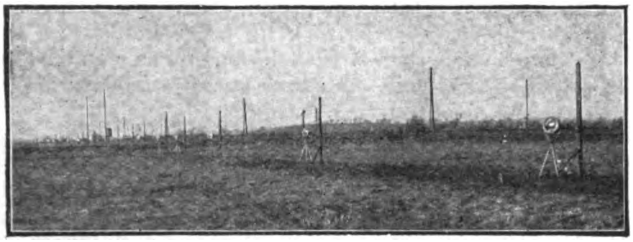


FIG. 3.—THE 26 B.T.-H. FLOODLIGHT PROJECTORS WHICH ILLUMINATE THE SIGN. THEY ARE 224 FT. AWAY FROM THE SIGN.

A night view of the sign is shown in Fig. 1. The photograph from which this was reproduced was taken by the unaided light of the projectors, and it gives a pretty good idea of the uniformity and intensity of the illumination. The wording of this sign can be read at night from a distance of one mile. Fig. 2 represents a daylight view and shows the sign during construction. If the picture is carefully inspected the reader will see that there are men on ladders working on the right-hand portion of the sign. This photograph gives a very good idea of the immensity of the advertisement, and the whole installation is an excellent example of the possibilities of floodlighting as an aid to publicity.

Full information regarding the installation will gladly be given by the British Thomson-Houston Co., of Rugby, and 77, Upper Thames Street, London, E.C.4, who supplied the projectors and the lamps, and who were also responsible for planning the layout.

CONFERENCES OF ENGINEERING SOCIETIES AT WEMBLEY.

The Society of Engineers is convening two conferences of the members and their friends (including ladies) of the institutions associated with it, which are to be held at Wembley, on Friday, June 6, and Monday, September 15. They will be held from 10.30 a.m. to 1 p.m., and after lunch, at 1.30 p.m., the members will be free to inspect the Exhibition according to their individual tastes. They will assemble for tea and social intercourse at 5 p.m. This will end the official programme, but, if a sufficient number should apply for tickets, provision will be made for these members to have a light dinner together so as to afford a further opportunity for the members of the various societies to become known to one another.

During the mornings, short papers on engineering subjects will be read and discussed.

The cost of tickets has purposely been kept very low in order to encourage young engineers to benefit by the arrangements. The price is 5s. 6d. each person for each day. This sum includes (1) admission to the Exhibition grounds and the conference; (2) lunch; (3) tea. The additional price for dinner is 3s. 6d.

Members of other societies will be supplied with tickets at the above prices, so far as accommodation will permit.

Application should be made at once to the Secretary of the Society of Engineers, 17, Victoria Street, Westminster, S.W.1.

VISIT OF OVERSEAS DELEGATES.

The Council of the Institution of Electrical Engineers have invited delegates from the following kindred institutions abroad to visit this country as the guests of the Institution from July 10 to 15 next:—American Institute of Electrical Engineers; Associacion de Ingenieros de Caminos, Canales y Puertos, Madrid; Associacion de Ingenieros Industriales, Madrid; Associazione Elettrotecnica, Italiana; Dansk Ingenirforening, Denmark; Den Norske Ingenirforening, Norway; Engineering Institute of Canada; Institute of Engineers (India); Institution of Engineers, Australia; Koninklijk Instituut van Ingenieurs, Holland; Schweizerischer Elektrotechnischer Verein; Societe Belge des Electriciens; Societe Francaise des Electriciens; South African Institute of Electrical Engineers; Svenska Technologforeningen, Sweden; Vereeniging van Directeuren van Electricitatsbedrijven in Nederland.

It is regretted that, on account of the large number of delegates, it will not be possible for the general body of members of the Institution to take part to any great extent in the functions arranged for the entertainment of the visitors, but members, associate members and associates will be given the opportunity of attending:—

(*a*) The luncheon at the Hotel Cecil on Thursday, July 10 (the presence of ladies at this function will be welcome).

The charge for luncheon tickets, inclusive of wines, will be 15s. per person.

(*b*) The Kelvin Centenary Banquet at the Connaught Rooms on Friday, May 11 (men only). Lord Balfour, O.M., in the chair.

The price of tickets for this function will be £2 2s. each (wines included).

Full particulars will be circulated in due course.

Chemistry for Everyone.—Chemical science is, for the ordinary man, a closed book, for its text-books are necessarily so technical that they are meaningless to all save the chemist. Now and again popular lectures are given on the subject, but these are too rare for general guidance. This want has now been filled by the preparation of a series of Chemical Industry pamphlets, to be published immediately, at 6d. each, by Ernest Benn, Ltd., which give a review of the applications of chemistry to manufacture, and, in non-technical language, tell the ordinary man the extent to which chemistry enters into his daily life in things he eats, wears and makes use of. There are eight pamphlets in all, covering a wide field of endeavour, and when ready they can be seen and purchased at the stand of S. Rentell and Co., Ltd., in Bay 14, Avenue 15, of the Palace of Engineering, at the British Empire Exhibition.

"LOPULCO" PULVERISED FUEL.

(SPECIALLY CONTRIBUTED.)

In view of the great attention that has been attracted of late to the subject of "Lopulco" pulverised fuel it is interesting to note that Messrs. The Underfeed Stoker Co., Ltd., who hold the manufacture and sale rights in Great Britain and other countries, have now issued a catalogue of this system.

There is no question that the development of pulverised fuel firing for steam generation has been extraordinary since the starting up of the well-known Lakeside installation at Milwaukee in December, 1920. The catalogue gives a list of about 70 large boiler plants, working or being fitted, which includes some of the largest and best known boiler plants in the world, as, for example, the Ford plant at River Rouge, Cahokia (St. Louis), Cleveland Electricity, the New Trenton Channel Station, now being built by the Detroit Edison Co. the Colfax station of the Duquesne Light Co. of Pittsburg, and the Gennevilliers and Vitry stations in Paris. In Great Britain two installations, Willesden and St. Pancras, are now also in progress of being equipped, and particularly significant is that a number of these stations have decided upon pulverised fuel in spite of the fact that they are in the foremost place as regards mechanical stoker efficiency.

The catalogue gives a short description of the essential features of the "Lopulco" system, including the new vertical gravity coal dryer using the chimney gases mixed with air for drying at about 215 deg. F.; the "Raymond" enclosed type of roller pulveriser mill, with a continuous current of air and automatic separation of the pulverised fuel by gravity, the average degree of fineness being 90 per cent. through 100 mesh screen and 65 per cent. through 200 mesh; cyclone collector and separator to disentangle the air from the pulverised coal; adjustable speed motor-driven feeders in which the fuel in any amount, mixed with 10 per cent. of the air required for combustion, is supplied through small-bore pipes to the burners of the vertical triplex type, each of which has its own independent feeder; large combustion chamber, with hollow air-cooled walls through which passes 90 per cent. of the air required for combustion, thus preventing wear and tear of the walls due to excessive temperature, and at the same time increasing the efficiency of combustion; and the patent water screen of 4 in. steel pipes in the bottom of the furnace to prevent the "slagging" or melting of the ash, one of the most characteristic portions of the "Lopulco" equipment. A detailed and non-exaggerated consideration is also given of the advantage of the method, the most striking of which is the extremely high boiler plant efficiency, 85 to 87 per cent. on continuous running, with only 20 per cent. excess air above the theoretical; the fact that all fuels from lignite to semi-anthracite and containing as much as 40 per cent. ash can be burnt at maximum efficiency; and the very great flexibility that is possible in the amount of evaporation; whilst the total auxiliary power for the complete operation is 20-40 kw. per ton of coal burnt, that is to say, about 1½ per cent. of the steam production. The latest type of equipment, as at Cahokia, Vitry, Cleveland, etc., is also remarkable for the small floor space occupied, which is, in fact, no more than mechanical stoking with mechanical ash handling, and for the fact that each boiler has its own independent installations; whilst on the Willesden plant there are to be still later developments, air heating instead of feed water economisers, additional to the hollow air-cooled walls, and the use in the combustion chamber of the "Detrick" suspended firebrick arch.

ELECTRICITY SUPPLY WORKERS.

As recently reported in the Press, an application has been before the Industrial Council for the electricity supply industry for a general advance in wages of 10s. per week to be given to the manual employees of the electricity supply undertakings throughout the country.

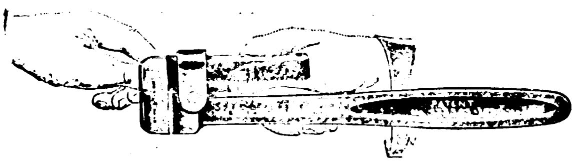
The employers have been unable to accede to the application on the grounds that the employees in the industry are better paid, and enjoy better conditions of service as to holidays, full time, etc., than practically all similar classes of employees in other industries, and the unions concerned are balloting their members as to whether they will resort to strike action or agree to refer the dispute to arbitration.

At a meeting of the employer members in Birmingham of the District Industrial Council the proceedings at the National Council meeting last week were fully reported, and it was made clear that although the employers' side of the National Council felt that no case had been made out on behalf of the workers, they urged that arbitration should be resorted to, particularly in view of the strong recommendation to that effect at the recent Court of Inquiry in the tramways industry, and of the great importance of public utility undertakings. The employers agreed to abide by the decision of the Court of Arbitration.

The local employer members are in entire agreement with this, and contend that there is no justification for strike action until constitutional procedure has been exhausted. The whole spirit of Whitleyism is the settlement of trades disputes by negotiation with an appeal to an outside arbitration if the two sides, employers and employees, are unable to agree.

A TOOL OF QUALITY.

"Woods" patent rapid adjustable wrench is quick and easy of adjustment and release, essential factors to the fitter who wishes to get work done quickly. No projecting nuts or bulky housing gets in the way, and there is no danger of nuts bursting or threads stripping.



Our illustration shows exactly how this extremely useful tool is operated. The locking piece is pressed down with the first finger and thumb supporting the shank handle, with the three remaining fingers on the under side. With the first finger and thumb on the sides of the loose jaw, bend down, pulling forward at the same time. This will open the jaw to the full extend, when it can be pushed back again to the correct size, either upon the work to be gripped or in the hands. At the low price of 5s. 6d., it may be said that they are "well worth it." The makers are Messrs. Wynn, Timmins and Co., of Birmingham.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of
CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

The B.E.E.

Wembley still continues its power of attraction, and the attendances are visibly increasing as the warmer days lend their inducement to the populace to wander about the grounds as well as the buildings. The gardens at the Exhibition are rapidly taking on a full summertime appearance, and the tulips in the beds nearest to the Wembley Park entrance are a mass of colour very pleasing to the eye. With regard to the exhibits, it is daily being borne in to the mind of the observer that a single day's visit to the Exhibition is of no use whatever from the standpoint of a detailed observation. There is so much to see in all but the smaller Colonial sections, that the very vastness and plenitude of the exhibits bewilders the eye, and one simply walks, and walks, and walks, until sheer exhaustion prompts a stoppage and the day comes to an end with the slowly accepted conviction that the visitor has seen practically nothing of any individual exhibit.

The only way of seeing the Exhibition thoroughly is to spend at least a week there, either continuously, or preferably, if it can be managed, in a broken succession of days with intervals between each two visits to rest the eye and ensure a fresh interest at the beginning of the day. Doing the Exhibition systematically is admittedly tiring, and if it can possibly be managed the visitor who intends to investigate everything offered for his entertainment and instruction should divide up his time and go to Wembley not more than three times in one week, following a prearranged programme on each occasion and avoiding overlap. The resident visitor in London, with ample time at his disposal, cannot do better than invest in a season ticket and go to the Exhibition just when and as often as fancy prompts him to do so; but many thousands of our readers will be less fortunately placed, and it is for the guidance of those residing at a distance from the Metropolis and only able to pay brief visits that I am offering this advice.

For the man who is interested in one particular class of exhibit and has limited opportunity of coming to Wembley, a careful study of the sectional guide to the Palace of Engineering or any other section which appeals to him is essential before he makes his visit. He should mark the exhibits likely to prove of individual interest, familiarise himself with their location in the vast building, and then, when the time comes, make for them in turn and systematically, allowing no other intervening stand to distract his attention from the objects he has in view. The great trouble with the average visitor who comes determined to see certain specific exhibits is that his eye catches an unfamiliar and attractive array of stands alien to his immediate interests, and in his inspection of them he wastes valuable time which should rightly be expended as originally planned.

From the trade exhibitors' point of view, it is becoming more and more obviously necessary to devise some means of attracting public attention to those stands which, due to their location or the nature of their exhibits, fail to catch the roving eye of the visitor among such a maze of structures, plant, and apparatus. The showman spirit is sadly lacking among some of the exhibitors. Stowed away in some of the smaller avenues or near corners which are veritable cul de sacs to the crowd, are many ingenious and attractive exhibits which fail to attract as they should do if the exhibitors rose to the occasion. In this connection much can be done by attractive flashing signs, kaleidoscopic effects and, above all, working models. For example, a well-known maker of rotary fans and blowers maintains an inflated rubber balloon, painted to represent the world, in a stable position without other support or anchorage, in the middle of a stream of air issuing from the nozzle of a blower. Public curiosity is inevitably aroused and the necessary interest excited in the accompanying exhibits.

Another firm of switchgear makers has worked out a very clever series of kaleidoscopic illuminated signs working in conjunction with the various forms of switchgear exhibited and demonstrating in a highly attractive manner the changes from star to delta, etc., when the switches are manipulated. Working models to scale of an electric railway and an illuminated tramcar are publicity stunts on two other stands staging a variety of products by two of the largest and most influential firms in the industry. In this connection one is prompted to the reflection whether it is always good policy to crowd any one stand with a large variety of exhibits.

Frequently the manufacturer staging an individual exhibit or class of exhibit is at an advantage because it stands out boldly by comparison with the larger mass of goods, and the visitor is able to concentrate on the one thing and learn all its advantages without his attention being distracted by surrounding objects. The staffing of individual exhibits is also simplified because it enables the specialist in any particular class of exhibit to preside and devote his energies more profitably than he could do as a unit on the staff of a firm showing mixed goods.

A Transatlantic Concert.

During the First Radio World's Fair, to be held at Madison Square Garden from September 22 to 28 next, a further series of experiments in transmitting musical programmes across the Atlantic is to be made. As previously, Miss Edith Bennett, the noted American soprano, has been engaged for the occasion, and radio enthusiasts will doubtless look forward to a still more successful reception than they enjoyed on the last occasion. Considerable progress has since been made in connection with long-distance transmission as well as reception, and it is fairly safe to assume that with the development work which is still going on, next September will witness a decided advance in the results achieved. A letter in our correspondence columns refers to the proposed concerts, and it will be noted that the publicity director of the concerts is anxious to collaborate with any station managers on this side who are interested.

Bravo, Hackney!

The Chief Engineer, Mr. L. L. Robinson, and Sales Manager, Mr. P. M. Shears, of Hackney Borough Council, have arranged for another demonstration of the domestic applications of electricity, and during the past fortnight a very interesting electrical exhibition has been held in the showrooms of the Electricity Department, Mare Street, demonstrating, *inter alia*, coffee-grinding and pulverising, meatmincing, sausage-making, etc. As on the previous occasion, enormous local interest was aroused, and there were many reader purchasers for the resultant products. This good work on behalf of the development of the supply industry is highly commendable, and Hackney's example ought to be widely emulated, especially by some of those supply authorities who at present take every precaution to hide their light under the proverbial bushel.

A Useful Tour.

A party of prominent and well-known engineers, including Mr. R. A. Chattock, Mr. C. C. Bell, Mr. E. H. Cockshott, Mr. J. H. Hillen, Mr. C. C. Usher and Mr. David Wilson, has been touring America for the purpose of investigating the latest developments in power-house design, and more particularly the application of powdered fuel to boilers. They visited the majority of modern power plants and journeyed as far west as St. Louis, including in their tour of inspection the Hell Gate Station of the United Electric Power Co., New York, the Sherman Creek station of the same company, and numerous other equally prominent plants throughout the American Continent. The tour was most interesting and instructive, and the party returned to England full of enthusiasm regarding the progressive position of American power plants. The thermal efficiencies of the plants inspected are higher than in this country, and by adopting powdered fuel the Americans are certainly using their coal to better advantage, not only in the direction of improved combustion, but also in reduced labour charges and simplicity of operation.

Elektron.

Correspondence.

THE FIRST RADIO WORLD'S FAIR.

Hotel Prince George,
14, East 28th Street,
New York.

To the Editor of Electricity.

Sir,—During the first radio world's fair, September 22 to 28, a series of ultra-important transoceanic broadcasting tests will be made under the supervision of a board of eminent radio engineers, in which I would be pleased to have the leading British broadcasting stations co-operate.

I shall be glad to furnish full particulars to all station managers over there who wish to participate upon application to me at the above address.

I fully expect the coming experiments to be as highly successful as was my now historic transoceanic radio concert, which was staged at Station WOR, near here, February 23, 1923. On that occasion, as you remember, Miss Edith Bennett, the noted American soprano, sang a complete recital in French, Italian and English, which was heard clearly in its entirety in 102 different countries by a collective audience of over 5,000,000 people.

We have already engaged Miss Bennett, who has been acclaimed as the world's finest radio singer, to take part in the coming experiments. She will give special radio concerts on the opening and closing days of the exposition.

Yours very truly,
Cal. Harris,
Publicity Director.

May 12, 1924.

Answers to Correspondents.

H. P. (Birmingham).—The chief cause of poor power-factor is lightly loaded induction motors. We agree that the cause of poor power-factor should be considered from two points of view—correction and prevention.

Invitation.—By the courtesy of the Post Office, the Chairman of the Wireless Section of the Institution of Electrical Engineers invites members to visit the Northolt Radio Station of the G.P.O. on Saturday, June 14, at 3 p.m. Those desirous of taking part in the visit should advise the Secretary of the Institution, when particulars as regards trains, etc., will be forwarded.

The **Relay Automatic Telephone Co., Ltd.**, of Marconi House, London, W.C.2, are issuing a neatly printed Wembley souvenir entitled "The Nerves of the Exhibition," and we are certain that it will be appreciated by any and every telephone engineer who visits Wembley, as well as by a large number of the general public, who may take more than a casual interest in the work of the automatic system which is used in the whole of the interior communications of this great Empire undertaking. The cover is an excellent photographic reproduction showing the main buildings of the Exhibition in panorama view, and is in itself a work of art which is likely to be kept by all who receive the pamphlet. We can, therefore, most cordially recommend early application for copies, which will willingly be sent on request.

HOARDING LIGHTING.

Illuminating engineers have realised the importance of well-illuminated hoardings for some time, and vigorous investigation of certain requirements to be met has resulted in lighting installation of which the illumination is uniform and of a sufficiently high intensity to cause the advertisements to stand out prominently. An installation which meets the above requirements has recently been erected outside the Tivoli Theatre, London. The units used for illuminating this hoarding consist of special "Wembley" reflectors, of which two are used, each containing an Osram 500-watt, ordinary type, gasfilled lamp. The energy consumption is 4.5 watts per sq. ft. of area illuminated, which is not too high for a well-lit thoroughfare like the Strand. In a district, however, where the intensity of street illumination is rather low, less than half of this expenditure of energy would enable the advertisements to be clearly seen.

Municipal supply authorities have shown a tendency to encourage this form of lighting, since it assists them to maintain their load as the industrial load is decreasing. For this reason, in some municipalities, a special rate is offered to encourage hoarding lighting. In some districts this is as low as 2d. per Board of Trade unit. This is not expensive when it is considered that most thoroughfares are thronged with people at night time, so the hoarding is working overtime at a small additional cost.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 180.

Can any reader inform me how I can obtain the value of the inherent reactance of an alternating current generator? I have no particular make of machine in mind, but current limiting reactances interest me and I cannot get any technical details.—"H. B. HURRY."

QUESTION NO. 181.

I wish to make up a condenser for a home-made wireless set with mica and tin foil. Can any reader give me constructional details, *i.e.*, thickness of mica, quantity of tin foil, and precautions to be taken?—"E. J. MORTON."

(Replies to Questions Nos. 180 and 181 must be received not later than May 31, 1924.)

Being led into temptation is the favourite sport of a weak mind.

ELECTRIC DRIVING OF A MODERN FACTORY.*

BY F. W. SMITH, N.A.S.E.

(Continued from page 261.)

LAURENCE SCOTT AND CO. SINGLE-MOTOR EQUIPMENT.

For rotary printing press equipments, Messrs. Laurence Scott and Co. have been chiefly indentified with the "Scott" Single-Motor System, although they are not bound to one particular arrangement. In some cases where there are certain advantages they advocate a two-motor system, with a small geared barring motor. The "Scott" Single-Motor System has, however, many advantages as regards simplicity and reliability, and up to 40 h.p. comes out rather less in cost than the corresponding two-motor system.

One thing that influenced Messrs. Laurence Scott in the early days of electrical driving for printing presses was the fact that they were exceptionally well-placed for making electric motors of more than mormal speed range, having had considerable experience in special designs of variable speed motors used in other trades.

One of the chief reasons why this system has been a uniform success, while some other single-motor systems have dropped out, is that the speed range of the motor by shunt control has never been stinted, at least 4 to 1 range being obtained thus, and the amount of control being left for series, regulation being therefore reduced to a minimum.

Another important feature being the special steadying device to prevent the speed from jumping away when the press gets a move on, whether the start is light or heavy. It is, of course, essential that a steady crawling speed of about 5 to 6 revs. per min. of the cylinders should be definitely obtained for leading in the paper. The starting torque, however, varies enormously from considerably less than full-load torque when the press is only part plated, up to twice or even sometimes four times full-load torque, when the press is running heavily (*e.g.*, in cold weather), or when the folder happens to have stopped just on the cut.

To obtain a steady start under these conditions, a steadying resistance or armature diverter is employed, connected across the armature for the crawling conditions only, but cut away in the next few steps as the press is speeded up.

A special feature of the controllers, whether the barrel hand-operated controller of the early days or the modern push-button equipments, is the selector device which keeps the steadying resistance in circuit until the press has started, but automatically arranged to cut out on the next few steps of the control. It is thus impossible to overrun on the controller the creeping condition, or on the other hand to leave the steadying resistance in for longer than necessary.

The push-button automatic controller, shown on a slide, was similar to those installed at many printing offices for magazine printing and for newspaper work.

It is constructed entirely on the "metal and mica" principle without any slate, marble or other unsatisfactory insulators by way of mounting. The whole of the gear was visible from the front, including all the connections, so that everything can be traced out by the maintenance man without difficulty, and the controller can be bolted straight up against the wall without the necessity of access to the back.

---

* Lecture delivered before the N.A.S.E.

On the right was seen the main master regulator worked by a large solenoid, and on the left a similar smaller regulator which, with the aid of a selector, operates the steadying resistance in the manner indicated above. Both these deal with small relay currents, or shunt currents only, so that there is no sparking or wear on the sliding contacts. All main connections are made by a series of contactors, which are seen on the extreme right and left of the controller which cut out main resistance, starting coils, steadying resistance, etc., as required for complete control.

The push-button stations consist of four buttons, "inch," "faster," "slower," "stop" and a safety switch with an indicator showing "locked" and "free."

The Motor Genertaor or Variable Voltage System.

This system was probably the first in existence designed with the object of obtaining varying speeds within wide limits with high torque at steady speeds.

Its application to the driving of rotary presses was extensive in the U.S.A. until the two-motor arrangement became popular. The advantages claimed for the latter were :—

(1). Immediate start.

(2). Greater capacity for overcoming inertia of press under bad conditions.

In the equipment I am about to describe, these objections have been successfully overcome, and in conjunction with its inherent advantages as an all-electric system, approaches nearest to the ideal. In this connection it is, I think, appropriate to mention that the eminent authority, Mr. Broadbent, stated some years ago in a paper read before the Association of Engineers-in-Charge the following :—

> " *Variable voltage control.*
>
> " Among the other systems which have been used are several modifications of the Ward-Leonard system. In this system the main driving motor is supplied from a motor-driven generator, the whole of the control being obtained by varying the voltage of the dynamo by means of a shunt field regulator, the dynamo being driven at a constant speed. This is almost an ideal system but is expensive, involving the use of three commutators."

The "Gem" system of Electromotors, Limited, consists of a motor generator and a main driving motor. The motor generator is specially designed from the point of view of supplying heavy current at a low voltage to the main motor for inching purposes, and the dynamo self-regulating, so that when the inertia of the press has been overcome the voltage is such that the main motor will continue to run at the predetermined speed and, furthermore, and most important, will supply the current at such voltage that the speed of the press at crawl, when the paper is being threaded through, is constant irrespective of fluctuation of load or the percentage of load compared to full load. This is an essential point, as presses are arranged so that papers of varying sizes may be printed and the press may be running as a whole unit, or any other smaller portion, usually two-thirds or one-third.

Briefly, this effect is obtained by providing both the motor and dynamo of motor generator set with compensating and compound windings properly proportioned.

Immediate Start.

The control is so arranged that the closing of the hand-operated D.P. switch excites the field of the main motor and simultaneously starts up the motor generator set. Obviously, therefore, pressure of the "inch" or "start" button, which through clapper switch closes the circuit between dynamo and main motor, means that the main motor immediately moves.

(To be continued.)

THE LIBERTY CRYSTAL RADIO RECEIVER.

We understand that Messrs. Radi-Arc Electrical Co., Ltd., Chiswick, have a new crystal set called the "Liberty" Crystal Radio Receiver, which will be ready for the market before the end of the present month.

We have received an advance circular giving some details of this instrument, which has some unique points. The outstanding feature is that the set lies flat wherever it is placed, and is not liable to be pulled over by a slight pull on the telephone cords. The receiver is circular in design and highly finished. It retails at a very low price, but at the same time substantial discounts are available to retailers. The set is mounted in a circular stamped metal case approximately 6 in. in diameter by 2 in. deep, highly finished in black enamel, with heavily nickel-plated terminals and metal parts.

Tuning is carried out on the variometer principle by means of the special type of variometer fitted. Two aerial terminals are available, so that the set may readily tune on either short or long aerials, in order to bring its tuning range within the limits of the broadcasting transmissions from various stations. The receiver has already been approved by the Postmaster-General, and will, therefore, receive between 300 to 500 metres on either a 30 ft. or a 100 ft. aerial, which is, of course, within the conditions laid down for approved sets.

The crystal-holder has a screwed cover, which facilitates changing crystals, and, at the same time, clamps them firmly and provides good contact. A special crystal is fitted which gives maximum efficiency, and the crystal adjustment is easily carried out, and firm, although light, contact is maintained between cat-whisker and crystal.

It is proposed to fit the set with a hook, so that it can be hung on the wall. When so fitted, below the set another hook is to be attached, in order that the headphones can be hung up below the set. In this way the set will be always adjusted and ready for use, and, although hung up out of the way, is instantly available. The aerial and earth wires in this case may also be kept well out of the way.

The tuning is effected by the centrally arranged knob which carries an open scale, and altogether the appearance of the instrument is excellent, while its operation is simple and very effective, and we predict for it a successful future.

Steel Hardening.—At the request of the City of Birmingham Electric Supply Dept. the Automatic and Electric Furnaces, Ltd., are carrying out a demonstration of their Wild-Barfield Electro-magnetic Hardening Equipments at the Corporation's showrooms, No. 21, Paradise Street, Birmingham.

NEW MARCONI PAMPHLETS.

We have received from Messrs. Marconi's Wireless Telegraph Co., Ltd., several pamphlets and booklets, illustrating certain of their specialities. As the subject matter of the booklet is of more than usual interest, we give a few brief notes relating to each, under their respective headings.

We have no doubt that the Marconi Company would forward copies to interested persons making application for them.

Sheets Nos. 28-32 are issued for insertion into pamphlet No. 217. These sheets describe the 3-kilowatt "U" type transmitter for use in aerodrome ground stations, naval ship stations, portable military equipment, and mercantile ship stations. The leaflets give full details with regard to range, wave-lengths, rating power, power supply, together with other technical data, such as aerial currents obtainable. Very clear illustrations of the set and its controls are shown, together with connection diagrams and outline dimensions of the respective parts.

Pamphlet No. 228.—This deals with Marconi general utility receivers, including direction finders and directional receivers. This booklet, in common with those that follow, could hardly be described as a catalogue, but is really a technical treatise on the special type of receiving sets designated by its title. Like the majority of the Marconi literature, it is clearly written and amply illustrated, and ships' operators would do well to obtain a copy, as it explains fully the principles of the direction-finder system used by the company, and the function of the respective parts of their apparatus, and includes a selection of beacon stations transmitting navigational signals, together with a selection of stations transmitting press.

Pamphlet No. 223/2 deals with Marconi multi-valve amplifying detectors, low-frequency magnifiers, and accessories. Here, again, the technical aspect of design is very clearly put forward, and the illustrations are particularly good. The booklet contains a number of useful diagrams, and shows various methods of connecting up standard apparatus in order to obtain desired results. The technical information contained is full, and the booklet is certainly of more value than many ordinary text-books on the subject.

Pamphlet No. 227/2 is a detailed description of a Marconi aerodrome ground station. It opens with a chapter on commercial aircraft communications, which very concisely covers the problems involved and their solution. A description of a station is then given, dealing with the various components, item by item, including power plant, emergency petrol plant, arrangements of aerials, earth screens, and earths; and the general layout of transmitting, receiving, and operating equipment is shown by a reproduction of the actual drawings of the buildings and layouts. One-and-a-half and three-kilowatt transmitter sets are described.

Land pattern direction finders are illustrated, with connection diagrams, and pictures of the aerial system, and full details are given of such accessories as local oscillation generators, both screened and unscreened. Portable receivers made specially for aircraft wave-lengths are included, and also what is now an important adjunct to wireless telephony, and that is a land-line voice amplifier, in order to give the high degree of amplification that is necessary to bring the distant subscriber's speech up to the necessary value. In these instruments, resistance capacity intervalve coupling is used, and independent adjustments are provided for grid negative potentials, in order to ensure practically distortionless amplification.

Leaflet 1024 deals with wireless for police work, and is a reprint of an article which appeared in the *Electrician* of March 14, 1924. It describes the equipment used for traffic control in the metropolitan area, and gives illustrations of the permanent and portable transmitting and receiving apparatus.

Pamphlet 1022 deals with the Marconi Magnetic Drum Recorder, which is a recording and relaying instrument for commercial telegraph reception. This instrument has a number of features peculiar to it, and, while the reader is referred to the pamphlet for these features, it is interesting to see that a speed of 650 words a minute has been attained with the instrument. The pamphlet gives illustrations and drawings, a description of the mode of operation, and specimens of records taken at various speeds.

Pamphlet No. 229 describes very completely Marconi Local Oscillation Generators. It opens with a chapter on the theory of rectification and detection, which is very clearly written and diagrammed. The theory of heterodyne reception is also discussed, together with one or two of its ramifications, following which local oscillation generators are described, and the uses of the various types, which are illustrated and outlined.

Pamphlet No. 226.—This will be of special interest to many readers. It deals with Marconi wireless apparatus for aircraft. Like the other booklets, there are a number of opening chapters dealing with the subject in general, such as notes on commercial aircraft communications, direction and position finding, and a brief chapter on types of aircraft, and general notes on their purposes and communication requirements. Various types of sets, their power, wave range, etc., are scheduled in a table, and in the following pages these sets are described and illustrated in considerable detail.

These booklets are worthy of the Marconi Company. They are well produced and printed, and of considerable technical value.

Reviews of Books, &c.

[Books noticed in this column will be sent from ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

INDUSTRIAL SWEDEN.—This work is published by the General Swedish Export Association in connection with the Gothenburg Jubilee Exhibition, 1923. It contains introductory articles giving authoritative accounts of the more important export industries as iron and steel, timber, woodpulp, paper, chemicals, engineering and electrical industries.

The main fact emerging from these articles is the remarkable extent to which Swedish industry is based on the natural resources of the country. Two other factors of importance are the faculty for technical inventions and the high standard of education of the Swedish people. It will be found that in every instance the industries described in this book have sprung from products of the forests or the ore fields, and that in practically every department inventions by the Swedes themselves have largely contributed to the solution of the problems set before the manufacturers.

The main part of the book is devoted to short descriptions of a large number of industrial concerns, and contains information of a practical nature, such as productive capacity, trade marks, agents, etc. A standard schedule has been adopted for these descriptions in order to exclude irrelevant matter. It must be borne in mind, however, that the book does not claim to give a complete account of Swedish industrial life. Owing mainly to their organisation, some large concerns are not represented, and some important export industries are not described. On the whole, however, "Industrial Sweden" can claim to give a good idea of the field covered by Swedish industry in general.

Various Items.

Personal.—We are glad to hear that our old friend, Mr. C. H. Wordingham, is now convalescent after his recent illness, and we hope that after a few weeks' complete rest he will return to business in his usual good health.

"**Telephone Meters**."—An interesting paper entitled "Telephone Meters and Coin-collecting Boxes," by Messrs. W. Cruickshank and F. McClarence, has just been published by the Inst. of P.O.E.E. It is a well-illustrated pamphlet of sixty pages, and the price is 1s. 2d net post free from ELECTRICITY office.

Finance.—The report of the Great Northern Telegraph Co., Ltd., for the year 1923 shows continued steady progress. Traffic receipts shew an increase more than sufficient to cover the automatic increase in the item of salaries and wages, and the directors propose the payment of a total dividend and bonus of 22 per cent. Lucky shareholders!

Trade Opportunities in Jugoslavia.—A report on the market for wireless receiving apparatus in Jugoslavia has been received by the D.O.T. from H.M. Consul at Zagreb, copies of which may be obtained by firms interested in the sale of apparatus and accessories manufactured in the U.K. upon application to the D.O.T. at 35, Old Queen Street, London, S.W.1 (reference No. B.X. 1010).

Quotations Wanted.—The State Electricity Works at Montevideo, Uruguay, invite tenders for copper wire and cable. They also invite tenders for the supply of a low-tension switchboard and accessories.——The Wellington (N.Z.) City Council invite tenders for the supply and delivery of one electrically driven multi-stage turbine pump, complete with all accessories, for the Korori Water Supply Works.——The Ministry of Railways, Marine, Posts and Telegraphs at Brussels invite tenders for the supply of 20,000 kilos. of bare phosphor bronze cable. Specifications, etc., at the D.O.T. (Room 52), 35, Old Queen Street, London, S.W.1.

"**Direction Finding by Reception**."—This is the title of a special report of the Radio Research Board of the Dept. of Scientific and Industrial Research, and has been written by R. L. Smith Rose, Ph.D., M.Sc., and R. H. Barfield, M.Sc. It is the first of a series of special reports dealing with the work of the Radio Research Board, and describes investigations which have been carried out on behalf of the Directional Wireless Committee of the Board, chiefly at the Board's station at the Admiralty Compass Observatory, Ditton Park. It makes a pamphlet of 27 pages, with ten text figures and one plate, and the price is 10d. net, post free, from the office of ELECTRICITY.

The British Industries Fair—London.—There was plenty to see "of sorts" at the British Industries Fair. The "sorts," however, were not the kind which would interest our readers, since the electrical exhibits were almost conspicuous by their absence. No doubt the counter-attraction of the British Empire Exhibition was responsible for this. One exhibit we did notice, and were interested in, was the display of wireless and electrical goods manufactured by J. J. Eastick and Sons. Incidentally, Messrs. J. J. Eastick and Sons informed us that they will be pleased to welcome readers of this journal at their premises, 2, St. Dunstan's Hill, E.C.3, where a large range of electrical samples is on show.

The Inst. C.E.—At the annual general meeting of the Institution of Civil Engineers, Mr. Basil Mott, C.B., was elected President, and among the Members of Council who were elected we notice the names of Col. Rookes Evelyn Bell Crompton, C.B., R.E. (T.), Mr. William Wyke Grierson, C.B.E., Sir Robert Abbott Hadfield, Bart., D.Sc., D.Met., F.R.S., Sir Cyril Reginald Sutton Kirkpatrick (an old Crystal Palace student), Capt. Matthew Henry Phineas Riall Sankey, C.B., C.B.E., R.E. (retired), Sir John Francis Claverton Snell, and Sir Alfred Fernandez Yarrow, Bart., F.R.S. (London), most of whom are also well known in the electrical profession.

Trade Notes.

A new 8pp. folder entitled "A Guide to Better Lighting," has been issued as an advert. of Mazda Lamps from the offices of the **British Thomson-Houston Co., Ltd.** at Mazda House, Upper Thames Street, London, E.C.4. It should be of use to all contractors and factors.

The **Vickers Spearing Boiler Co., Ltd.**, have recently acquired the sole British and Colonial manufacturing selling rights of the Illinois Chain Grate Stokers, and for the purpose of making this fact more widely known they have issued a well printed and clearly illustrated catalogue giving full particulars of the stokers, and also of the Illinois flat suspended arch and the Illinois water back. The catalogue should, therefore, appeal to all central station engineers and users of heavy steam boiler plant, to whom it will willingly be sent on application to the company at 20, Kingsway, London, W.C.2.

From **S. H. Collett**, 52, Hampstead Road, London, N.W.1, we have received a circular describing his Excel Terminal Clips for wireless and all electrical apparatus, as well as samples enabling us to make practical tests of the claims made for their quality. We think that they should find a ready market among all dealers in wireless and other electrical goods, and recommend application for a copy of the circular.

"The Business World" is the title of a very charming booklet which has been issued by Messrs. **F. W. Berk and Co., Ltd.**, the well-known chemical specialists, of 1, Fenchurch Avenue, London, E.C.3. It contains some excellent illustrations of the leading commercial capitals of the British Empire, concluding with a brief description of the company's great works at West Ham, together with illustrations and particulars of the goods specialised. It is quite a nice, handy little book, and readers of this paper who may wish to obtain a copy should make a point of asking for it at Stand A44 in the Palace of Industry, chemical section. It will be supplied with pleasure, and it is to be hoped that the company's enterprise will be rewarded in an increased turnover in its staple manufactures.

GRINDERS
DRILLS
"DEPENDABLE"
& POLISHING LATHES
MARRYAT & PLACE, ENGINEERS.
28 HATTON GARDEN, E.C.2.

Sample Pair Sent on Approval for 8/6
Made of Pure Para Rubber, soft and durable and unaffected by climatic conditions
DAVID MOSELEY & SONS,
Limited,
ARDWICK, MANCHESTER.
MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

JUNE 6, 1924.

CONTENTS.

PAGE
The Small Man's Opportunity 289
Uses and Abuses of Various Types of Electric Lift Control .. 290
About this Power-Factor 291
London-Bristol Telephone Cable 292
Current Topics 295
Electric Driving of a Modern Factory 297
Questions and Answers by Practical Men 298
Telegraphy 298
The G.E.C. Engineering Bulletins 299
New Mullard Valves 299
The Story of a Wireless Hoax 300
Adieu, but Not Farewell 302

THE SMALL MAN'S OPPORTUNITY.

By F. A. R. Paton, M.A., A.C.W.A.

During times of depressed trade, such as the present, there is but little chance of rapid advancement for employees of large firms, so that some courageous and ambitious persons, dissatisfied with their slow progress, begin to ponder the advisability of setting up a business on their own account. A man who has been employed by an electrical contractor might turn his attention to the possibilities of starting business as a wiring contractor. He sees before him considerable possibilities in such a business, for the capital required is not large, and the demand for work of this nature, on both a large and small scale, is in daily evidence in the newspapers and in the shape of the new houses which are now being erected in and around large towns. Besides new work, there is a fairly constant demand for repairs in works and shops, as well as in private houses.

Competition is, however, extremely keen, and the number of tenders submitted for public contracts, of even small value, is invariably large, and in almost every case the deciding factor is the price, the lowest quotation being awarded the contract.

To some extent this is to the advantage of the "small man," because larger competitors, especially those who undertake other work besides wiring contracts, are at present compelled to run some of their departments at a loss, through lack of work. Their factory or workshop is equipped with plant and machines which cost money, even when they are not being used. Money has to be found to pay for this "idle capacity," and the money can only come from one of two sources. It must either be taken out of the profits on contracts obtained, in which case their price must perforce be higher than that of the contractor who is in a smaller way of business and has only just sufficient plant for his present needs, or else the money must come out of the reserves, a process which can only go on for a strictly limited period.

The "small man," unhampered by expensive plant which is lying idle, or only partly employed, has, in consequence, certain real advantages at the present time by which, provided he is wise, he can benefit; this advantage is not so great that he can afford to be careless, for his way is beset with temptations, and he must walk warily. It is so easy to overstep the mark and become a price cutter, that many fall into this trap at the outset.

When fixing a price for a contract, some small wiring contractors add up the cost of the materials from their suppliers' lists, estimate the time they will take over the job, and fix a price for wages, using the sum of these two items as a basis of negotiations, confidently believing that anything they can get over and above this figure will be satisfactory, since it will be a contribution towards their rent and rates. Such items as depreciation are forgotten in the stress of the moment, and it is not until the annual accounts come to be made up at the close of the year that their accountant, or possibly some good friend who is a book-keeper, reminds them of the necessity of including this unpleasant item in the profit and loss account. Depreciation often turns out to be no small drain on the resources, for tools and other necessary plant are usually bought out of capital as required for work in hand with the idea "Oh, well, we would have to get that sooner or later in any case, and it will always be useful. It will still be part of our capital."

The amount of money spent in this way grows without being noticed, for there is not time to go through the accounts every week and see how much capital has been spent and locked up in tools and plant, and it never seems much when spent in driblets. It is a very different tale at the close of the year, when these tools, which accountants like to call "assets," come to be depreciated at 15 per cent., with the result that £20 or £30 have to be taken out of profits for a reason which does not always commend itself to a man who has recently started business on his own.

The demands of accountancy will not relent, however hard they may seem, and it is too late for the unfortunate young contractor to think: "Why did I not charge old Mrs. Jones another £20 on that job I did for her? I could easily have got it."

The troubles of the "small man" nearly all arise at the same source. It is not because they do not make the most of their contracts for Mrs. Jones that their profits are smaller than they would like them to be, but rather because they seldom have a sound basis upon which to build up and determine a selling price. Even the price they have to pay for materials—the tumbler switches and the lamp fittings—are not always known for certain beforehand, because the discounts and commissions they get depend on their ability to pay promptly and on the quantities they order. The time the job will take and consequently the labour cost is seldom anything better than a considered guess, which is more likely than not to require adjustment on account of unforeseen difficulties which arise. As for allowing anything in the private estimate of cost for such items as depreciation, maintenance of own plant, allowance for the cost of making tenders (on other jobs) and the hundred-and-one other items of "overhead," which even the smallest business cannot escape altogether, the best that seems to be done is to include some round figure, supposedly to cover the lot. Sometimes not even this degree of accuracy is considered necessary.

To evolve a selling price from such a result is just as likely to bring a loss as a profit, the chances being in favour of a profit on small jobs and losses on larger ones, because the figure for "overhead" or for "profit and overhead together" will not assume such frightening proportions on smaller jobs.

The final result of a year's working is seldom known, even roughly, until the books are balanced at the close of the year, and then it is only the result of the year's trading as a whole—and no facts concerning which jobs have turned out to be remunerative and which have not—that is determined. Disappointing results lead to lack of confidence; loss of orders are attributed to prices asked being too high, and they are accordingly cut in a drastic manner, with even more disappointing results than before. The one advantage which the "small man" has is apt to be forgotten or lost sight of amongst other troubles, and that is the fact that he has less expense to meet than his larger, but only partly occupied, competitors.

If the "small man" will but learn how to work out his costs accurately, particularly his overhead expenses, and use these figures confidently as a basis for fixing his selling prices, by adding a reasonable percentage for profit, he will find that his work will be remunerative and that he will be in a position to compete favourably with larger contractors, without having to resort to the damaging practice of price-cutting.

It seems to be a prevalent belief that accurate costing is necessary only for large firms, and that it is of no service to small firms because so much clerical labour is involved. This reasoning is entirely fallacious and indicates a lack of knowledge of the fundamental principles of costing.

The keeping of costs records is not an additional function to keeping books of account, but an integral part of it; in fact, the whole object of costing is to make the accounts "live" so that they will become really helpful in showing progress month by month, or week by week, without involving the great labour of balancing every account. The essential difference between costing and the old-fashioned way of book-keeping is that the former classifies accounts according to "purpose," whilst the latter classifies them according to their "nature," so that costing distinguishes at once, without long calculations, between jobs which have brought in a profit and those which have resulted in a loss. Costing also shows at once something which is more important—namely, *why* certain jobs have turned out to be unremunerative.

Catalogue 595, Wireless Sets and Accessories, just issued by **Siemens Bros. and Co., Ltd.**, is a new and enlarged edition under another title of the "Accessories for Private Wireless Installations" list, and, as its designation implies, it now contains illustrations and descriptions of wireless receiving sets of various sizes. These range from the self-contained three-valve, type M.I.P. set at £39 to the simple crystal set, type 125 at £2 10s. The former set is completely self-contained and portable and is primarily intended for use in flats and other places where it is difficult to erect an aerial. Another three-valve set is listed—namely, the type S.B. 39 at £38—which has been designed to make reception possible from any British broadcasting station without interference from any other such station operating within a radius of five to ten miles. And finally there is the well-known C.V. receiver, which has now been on the market since 1922 and which combines a crystal detector and a single valve, either of which can be employed independently, or the two can be used together. A very complete range of accessories is also listed including telephone head sets, loud speakers, aerial equipment, primary cells, batteries.

USES AND ABUSES OF VARIOUS TYPES OF ELECTRIC LIFT CONTROL.*

Experience has taught us that the layman's ideas on the suitability of various types of lift control, from the point of view of efficient traffic service, require reconsideration.

The types of control most used in present practice are:—

1. Car switch, in which control is obtained by means of a simple two-way switch in the car.
2. Semi-automatic, in which motion in either direction and stopping is obtained by suitable pushes arranged in groups of three, labelled "Up," "Down," and "Stop," respectively. One of these groups of pushes is placed at each landing entrance and in the car.
3. Automatic control, in which the lift is called to any landing by a single call push and sent to any landing by means of a full set of pushes in the car.
4. Floor steering automatic control, which differs from the automatic control in that full sets of pushes are provided at all landing entrances as well as in the car. Thus full steering is obtained from all points.

It requires little intelligence to discover the primary difference between these various methods. The last three enable the lift to be operated by unskilled persons, thus eliminating the necessity for the presence and expense of the skilled operator essential for a car switch machine. This obvious advantage has proved a stumbling block to many who have not stopped to consider the question from its other and often more vital standpoint, that of efficient traffic service.

The most efficient traffic service in any given case is that which can transport the greatest number of passengers or amount of goods in the shortest space of time. This at once introduces the question of the speed at which the lift travels, and brings to light the first disadvantage of the automatically controlled lift. Owing to reasons unconnected with the question under consideration it is not sound lift practice to operate push-button lifts at a greater speed than 150 feet per minute. Car switch lifts, on the other hand, can be and are operated at speeds up to 400 feet per minute in this country, and 1,000 feet per minute in America.

A further disadvantage of push-button control is its selfish nature. By virtue of the safety equipment provided with an automatic lift, one person occupying the car has its complete control and use until he finally leaves the car and shuts the gate behind him, no matter how many other persons may be requiring it. Assuming a person on the ground floor desires to reach the eighth floor. He will call the lift, and, having obtained same, will go from the ground to the eighth floor, and until he has completed his journey, no other person will be able to receive any service. Furthermore, should he inadvertently omit to close the landing gate on leaving the car, the lift will be out of action until his omission has been rectified.

A car switch lift, however, in the hands of an intelligent operator, can pick up passengers at intermediate floors, so that every intending passenger receives his due share of service.

It is seen, therefore, that in all cases where rapid traffic service is required, car switch control is undoubtedly the better method to adopt.

---

* From the *Engineering Gazette.*

ABOUT THIS POWER-FACTOR.

By G. E. MOORE, A.M.I.E.E.

II.

In the previous article, last week, I tried to give a simple idea of the conditions in an alternating current circuit which bring in the so-called "power-factor." I showed that in such a circuit, with the *applied pressure* alternating all the time, it was possible at any moment you could choose for the current to be lagging or leading that pressure—or, as I preferred to put it, *slow* or *fast*. I emphasised that such time difference is the root of the whole matter. There are, I know, two things in particular which puzzle the beginner, and I had better clear these up first.

TWO THINGS THAT WORRY THE NOVICE.

Number one trouble is the strange way in which the pressure and the current are regarded as two entirely separate things. Many, while not denying that the pressure must be there, think of it only as a vague term and never seem to consider problems except only as a matter of amps. That's a big mistake, especially when you come to consider what happens when an alternator is the source of supply. Remember—the *power* in watts = pressure × current. You can't leave the pressure out of your calculations. Last week we saw how, if the current acts at a different moment to the pressure, the watts are less than the (volts × amps.) value. The *power-factor*—the factor which you apply to get the true, effective power and all that counts so far as getting work done—is bound up with this.

The second trouble met with is the difficulty of grasping what is the vital difference between direct current and alternating current. The former you imagine as being definite and, perhaps, dependable! With the other, however, there is a kind of unending swing backwards and forwards. The double movement is called the *cycle*. Now let's see what happens during a cycle.

At first the pressure is nil, and no current flows. Gradually the pressure rises, then falls to zero, rises again in the opposite sense, and then returns to zero. The current which results goes through the same rigmarole, but here you can think of it as actually flowing through the circuit in one direction, and then returning. With this picture in your mind just try to feature what happens if the current is *fast* or *slow* compared to the applied pressure. At any rate, you can foresee strange effects.

We have just had a look at what goes on in one short cycle, but the life of an alternating current is composed of many such following each other at a rapid rate. In a supply system there are about fifty cycles per second, or, as it is called, a frequency of fifty. And so a condition which exists in one cycle (like a power-factor condition) is there to worry you all the time. It is because of this that the current (as I stated last week) can *remain* fast or slow to the pressure.

POWER-FACTOR EVERYWHERE.

At one time I never used to think of power-factor except as existing in alternating current supply systems. But I found in time that it keeps cropping up in all sorts of places, though not always under that name. I gave you a hint last week that an inductance or a capacity can occasionally give trouble under continuous current conditions—the trouble which with A.C. persists all the time. Well, inductance and capacity are two things which turn out to be rather difficult to get rid of if they are in the way, and they await you in unexpected places.

For example, a simple piece of apparatus like a resistance shunt can have the power-factor condition, and its behaviour on A.C. will be different from that on D.C. In a large coil of resistance wire the induction due to the turns can be quite big enough to cause serious errors on A.C., and special care is taken to wind it *non-inductively* and so avoid the time difference. Yet, in a large resistance, having avoided the inductance snag, our other friend, capacity, can show himself and prove nearly as big a nuisance. This is because there can be a condenser effect not only between layers, but between turns. You see, then, that winding a resistance is not necessarily a simple job, and that power-factor condition can appear in more ways than one.

Then in instruments like voltmeters, and so on, "chokers" and the like, where you have windings plus a magnetic iron circuit, the current lag can be very big, though not necessarily a worry. In transformers for varying the power, or pressure, or current, the time difference between the pressure across the terminals and the current inside can give the transformers an internal power-factor.

Take the case of a current transformer used with a meter. Here the internal time-difference is very small—somewhere about 1-18,000 second; but small though it is, it can make the meter one or more per cent. inaccurate. And here is a curious and useful fact: The meter itself has its own power-factor condition and this is compensated for; when you compensate for this you can also allow for the same trouble in the current transformer used with it, and so make the meter measure correctly.

P.F. CONDITIONS AND "WIRELESS."

I am sure that among the readers are many who are under the spell of "wireless" and have "sat up and taken notice" at the mention of frequency, inductance and capacity. Can power-factor conditions appear in their gadgets? Yes! As a matter of fact such conditions are deliberately encouraged, though you don't actually hear the term "power-factor" coming into wireless jargon. The current in an inductance, as yo will remember, is *slow* and that in a condenser *fas* Between the inductance and the capacity there is time-interval. The condenser discharges into the inductance and empties itself, and the inductance, having thought the matter over, so to speak, makes the current flow back. The condenser responds again, and so you get a pendulum effect which goes on at a frequency of many thousands per second. See how vital, then, is the behaviour of each.

Such a circuit, as you know, can be *tuned* and the incoming or outgoing wireless signal sets up and keeps going the easily excited backwards-and-forwards surging. By altering the tuning you vary the frequency, and as the speed of the waves = wave-length × frequency and the speed is always the same, by tuning you alter your wave-length.

I have told you that at one time I did not think of power-factor and what the condition might mean except in connection with industrial supply; but experience in an instrument works on the making and calibration of small and large resistances, inductances and condensers brought home to me the fact that the condition doesn't by any means only crop up when a consumer installs a squirrel-cage induction motor! I have told you something of the difficulties which arise. Perhaps you can guess at the trouble which self-capacity can cause in an inductance of, say, one Henry—roughly 2,300 turns of wire; and how instrument leads and your own capacity have to be closely watched. And readers who have dabbled in wireless will know how vital it is sometimes to *isolate* inductance and capacity, and how these can turn up and become bugbears when not wanted at all.

Power-Factor in an A.C. Supply System.

We have now seen how the conditions which bring in power-factor are fairly widespread—how, under alternating current conditions, a time-difference between the pressure and the current gives a smaller value of power than you expect, and how this time (or *out-of-phase*) trouble can crop up in all sorts of ways and places. But the power-factor bugbear is generally thought of in connection with A.C. supply systems and circuits. Let us see how the out-of-phase trouble comes in here.

Before you have got away from the power-station there are incidental examples in the generating and auxiliary plant which show you that inductance is there to cause a little power-factor mischief. Then, too, the transmission lines and cables account for more inductance, but this is somewhat offset by the capacity which also exists. It is when you get to the consumers, however, that you find the chief source of power-factor inefficiency. A lighting load is only slightly inductive and need not concern us; but plant—mainly in the shape of motors—presents an enormous amount of highly inductive stuff. Motors of the squirrel-cage type are the worst offenders among running machinery; transformers on *no-load*, though not very serious, are still serious enough with their very low power-factor.

As you will readily tell, the industrial load that is put on a supply system is the kind which, being in the main inductive, makes the current lag—*i.e.*, slow with regard to the pressure. As a result of the mixed load that is taken from a widespread system feeding consumers with lighting and with power of varied power-factor values, the alternators run at a power-factor ranging round .75.

Well, what of it? Does the power-factor condition matter to anybody—supplier or consumer? The power in watts is given and the work is done, so you might think that if the current wants to lag—why then, let it lag. That seems all right at first sight, and, indeed, there was a time when nobody bothered much over the existence of power-factor. But with the growth of the industrial load and the spread of A.C. supply, P.F. began to be prominent, and it was seen to be the nuisance and source of inefficiency it is. Power-factor in recent years has become a much-discussed problem, and *why* it is so will be considered next week.

(*To be continued.*)

A good neighbour is one who, after clearing his own sidewalk of snow, clears ours. But we've never seen him.

LONDON-BRISTOL TELEPHONE CABLE.

The Postmaster-General announces that the London-Bristol telephone cable, which is one of the main links in the network of underground cables now in course of construction, was brought into service on Monday, June 2.

The cable, which is 122 miles in length, will be the channel for communication between London and the West of England, and will enable direct communication to be established for the first time between London and Plymouth. It is so designed that, in the event of any fault developing on, say, the London-Birmingham cable, communication between London and Birmingham will be maintained via Taplow, Marlborough, Bristol and Gloucester.

This new cable contains 616 wires, which could provide 462 channels of communication, thus ensuring very rapid connection. The total weight of copper per mile is approximately 5½ tons, whereas on an overhead road line the same amount of copper would provide only sixty wires. This reduction in weight has been rendered possible by the introduction of telephone repeaters, the cable being divided into three sections by repeater stations at Taplow and Marlborough. The Taplow station is the first of a series of large independent repeater stations for operation in connection with the national and international telephone services, and will be followed in time by similar stations at various points of the underground network. It is equipped with some of the most delicate apparatus used in telephony; the apparatus is, in fact, so finely adjusted that the amount of current sent into the repeatered-circuit by the transmitter and the current received from the line by the receiver is as nearly as possible the same as is obtained when a transmitter and receiver are connected by a short line. The vital element is the thermionic valve, which is marked by important differences in design from the wireless receiving valve. The telephone repeater valve is the result of many years of research work on the part of the Post Office engineers, assisted by the research establishment of the General Electric Company.

A modern underground cable circuit, with its associated repeaters, costs considerably less, both in capital and annual charges, than an equivalent overhead road line circuit, without taking into account the loss of working time that is unavoidable on aerial lines.

Exhibition of Inventions.—The Institute of Patentees, of 44, Great Russell Street (opposite British Museum), London, W.C.1, will hold an Exhibition of Inventions, from August 11 to 16, in Aldwych House, Kingsway, W.C.2. Monetary prizes will be awarded for the best inventions, and there will be two prizes for women. The object of the prizes is, firstly, to give a stimulus to those who have inventive genius, to bring out inventions of value to the nation, and, secondly, to assist inventors with the disposal of their patents. The Exhibition will be divided into the following sections:—(1) Domestic and labour-saving (excluding mechanical and electrical); (2) mechanical (excluding I.C. engines, etc.); (3) electrical (excluding wireless); (4) I.C. engines and inventions appertaining thereto; (5) wireless; (6) building; (7) novelties and toys; (8) miscellaneous. The prizes will not be sectional. The following ladies and gentlemen have been asked to act as judges:—Prof. A. M. Low, D.Sc.; Sir W. Grey-Wilson, K.C.M.G., K.B.E.; Prof. P. M. Baker, B.Sc.; The Lord Leverhulme; The Duchess of Atholl, M.P.; Capt. P. P. Eckersley; The Lord Askwith; The Lady Terrington, M.P.; The Rt. Hon. Sir W. Bull, Bart., M.P.; Miss C. Haslett; W. J. Dow, Esq.; J. B. Bower, Esq.; R. O. McGown, Esq., F.S.E.R.A.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of

CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

Phew!

In less than a fortnight our notorious climate has changed from mid-winter to mid-summer, and as a result a minimum of clothing, iced drinks, sunshades and electric fans are the order of the day. In the Palace of Engineering at Wembley we are experiencing a sample of what the summer of 1924 has in store for us*, and it is evident that the prevailing glass roofs are going to conduce to a hothouse existence very shortly if steps are not taken to shield us from the more direct rays of King Sol. I believe that experiments to this end are already in progress, meanwhile the purveyors of electric fans of all descriptions should drive a roaring trade alike among fellow exhibitors and the public. Withal we are not complaining, for the fine weather has contributed to much larger attendances, and every day sees crowds perambulating the various avenues of all sections of the exhibition, whilst the gardens, with their riot of colours, provide very attractive seating and strolling accommodation to the accompaniment of excellent bands.

Among the needs of the moment is the aid of interpreters who possess a moderate general knowledge of the nature of the various exhibits and can speak several languages. With so many visitors from abroad one frequently comes across small groups of obvious foreigners vainly endeavouring to make themselves understood by a hot and bothered stand attendant whose school French and German, long since forgotten, mark the limit of his knowledge of other tongues than that of his own country. In some few cases the enterprising foreign visitor has foreseen the difficulty and has brought with him a friend and compatriot who can speak more or less fluent English and acts as interpreter. In this connection it is worthy of more than passing note that the foreigner can, as a rule, speak better English than some Englishmen born and bred, and in general, if he speaks our language at all, does so more fluently than the Britisher converses in any foreign language. This weakness on the linguistic side is a serious handicap to us in our foreign trade.

The friendly atmosphere prevailing between exhibiting firms who are ordinarily keen competitors one with the other is most marked, and leads to some amusing incidents. For example, only the other day I saw a man presented with a cigar by the stand attendant of a well known manufacturing concern, and which he promptly lit up with the aid of a match taken from one of those advertising novelty packets which he had just received from a near-by competitor of the same concern. The incident marked the consorting of the lion and the lamb, and the humour of the situation was increased when a third competitor invited the visitor to wash it down with a whiskey and soda at the nearest bar. Nor does the spirit of amity stop at third hand passages of this description, for rival firms give one another friendly demonstrations of each others products and discuss the respective merit of their wares as if neither had anything in common competition. This is all as it should be, for exhibitors have nothing to hide and a complete exposé of all the latest practice is good for both the community, trade and the profession.

Exhibition Literature.

A noticeable feature of the Wembley Exhibition is the comparative paucity of literature dealing with the multifarious exhibits. Literature there is in plenty, if one is particularly interested in any given exhibit and cares to ask for relevant paper, but at a tremendous World's Fair of this kind it would be foolish to place abundant literature at the disposal of every Tom, Dick and Harry who comes along with only a curious interest in what he sees. Moreover, general visitors do not care to be burdened with sheaves of leaflets which sooner or later become an incubus, and more often than not are ultimately abandoned by the recipient before leaving the Exhibition precincts. The most amusing side of the literature question concerns the many schools which, with the advent of the holiday season, are now paying daily visits *en bloc* to Wembley.

The boys come along invariably armed with huge school bags or satchels, in which they stow away every scrap of paper they are able to lay hands on, whether it is of interest or no. Paper collecting is apparently a craze with the younger generation, and towards the evening one sees groups of youngsters struggling along with grievously over-filled bags of catalogues, leaflets, etc., on all sorts of subjects, from refrigeration to Super-Kreem toffee. It is amusing to witness a raid on any stand by these schoolboys where the slightest trace of paper is visible. Small piles of leaflets disappear as if by magic, and it is as if a swarm of locusts had passed that way leaving bare boards where previously stacks of paper rested. Some firms have got wise to the dodge, and carefully remove literature from the front of the stand immediately they spot a school in the offing. On the other hand, one never knows where these papers end, and a percentage at least may reach fruitful soil and interest some prospective purchaser of the goods described therein. At all events, some of the more technically descriptive matter is doing its bit by way of educating the rising generation to the possibilities of modern engineering and industry.

---

* Followed in due course by the proverbial thunderstorm.—ELEKTRON.

Kelvin and the Styx.

Although the general lighting of the Exhibition now leaves little room for criticism, there is one point, and that is a very important one in its relation to the B.E.A.M.A. section of the Palace of Engineering, which calls for urgent reform. The Kelvin Gate, which gives immediate entry to the B.E.A.M.A. section and the E.D.A. Electricity in Service exhibits, and is the first entrance from Wembley Park Station, has a short flight of steps leading up to the entrance from the colonnade. On dark evenings these steps are shrouded in gloom, and the crowd can be seen gingerly negotiating the unknown levels at this very vital point. One lamp of fairly high candle-power would solve the difficulty once and for all, and it is the more surprising that this essential illumination has not yet been installed, seeing that the entire length of the colonnade itself is amply lit by rows of cornice lights. The sooner this omission is rectified the better and safer for the visiting public.

Feeding the Multitude.

Last Saturday was a record for attendances, nearly 170,000 people passing the turnstiles. As a result there was an unprecedented demand for food and refreshments generally, and Messrs. Lyons' catering arrangements were put to a very heavy strain, inasmuch as everybody expects to be fed at or about the same time. No doubt the Whitsun crowds will be even greater than those hitherto recorded on the more popular holidays and half-holidays, and the wiseheads will either take the precaution of coming prepared with light refreshments of their own to be used in case of necessity, or, failing this, will dine early or late, as the case may be, and thus relieve the strain upon the many restaurants during the rush hours from 1 o'clock to 2 o'clock. In this connection it seems rather a pity that there is no canteen service available for the very numerous Exhibition staffs who, after all, need their food regularly if they are to do justice to their exhibits during the whole twelve hours. It is to be hoped that Whitsun will not see a repetition of the Good Friday fiasco, when food ran out at mid-day and the holiday workers had to carry on half-starved until the middle of the afternoon.

Automatic Telephones.

The example of the British Post Office in adopting Strowger automatic telephones for Greater London has been speedily followed by the Japanese telephone authorities at Tokyo, where an extensive Strowger installation is contemplated to replace the manual system damaged by the recent earthquakes. The contract for this equipment has already been placed with the British manufacturers of Strowger apparatus, and marks another stage in the rapid development of this system of telephony in the Far East. Now that the world's leading telephone engineers have satisfied themselves as to the practicability of the Strowger system for the largest cities as well as for the many towns throughout the world, in which it is already installed, we may look forward to a more or less rapid conversion of the existing manual telephone installations in all important centres of population both at home and abroad.

Niagara Falls Threatened.

It comes rather as a shock to read that the famous Niagara Falls in the North American continent, so intimately connected with the generation of electric power from water, are actually threatened with extinction. For some time it has been recognised that the limit of energy in the falls was in sight, but of a sudden the position has been seen to be more serious that at first thought. A writer in the Boston *Transcript* has stated the position in this arresting manner:—"It has come to this, that to see Niagara at its best one must visit it on Sunday." By mid-week the claims of industry *and households* are such that "great stretches of rock on the crest of the falls are uncovered, and the waterfall has retreated a considerable distance from the shore line." Yet, it appears, more power than ever is needed—famine is in sight!—and authorisation is being sought by interested engineers and financiers to divert more water.

As I said, the above news comes somewhat as a shock, though perhaps largely because of the spectacular nature of Niagara. We are periodically treated to power-famine shockers of this description. For some time it has been understood that the coal resources of Great Britain are showing signs of depletion, though our generation is not to suffer; once or twice we have been assured than an oil famine is a possibility. Even the illimitable air has been having limits set upon it. Taking a long view (exceedingly long, fortunately!) the sun's energy is gradually being exhausted, while our own earth is slowly *wearing away*. But why should we pay any attention to all these scares and bogeys anent our power resources vanishing? Let them! Surely after all these wonderful latter days of scientific progress we are not going to imagine that fresh and more efficient—yes! and readier—resources are not to be tapped. It looks as if, now that the electrical nature of all matter is more or less undisputed, that eventually all the sources and utilisations of energy will come within the growing boundaries of electrical engineering. That is an immense thought.

A Great Problem!

Curiously enough, I had no sooner written the above than my eye lighted upon a cutting I took some time ago from the columns of the *Northampton Gazette* (the journal of the Northampton Engineering College, Clerkenwell). A writer who introduces himself no further than by the initials "F. M. D." (perhaps wisely) proceeds to deal in real student manner with the burning question as to "whether electrical engineering offers more opportunities than civil and mechanical engineering." This is how he answers (you will see the connection between this and my previous paragraph):—

> "In its literal meaning electrical engineering is the whole art of producing effects by means of electrons, and since all known effects are produced by electrons, it follows that electrical engineering

> embraces all known events, and such arts as civil and mechanical engineering merely are subsidiary branches of electrical engineering—they have been called, rightly, its handmaidens."

Hard lines on civil and mechanical engineering, eh?

But he is even better when he gets going upon *the job of finding a job.* Hearken:—

On Finding a Job.

> "The obtaining of a post is a complex matter: a function of *B*, *S* and *C*, where *B* stands for bluff, *S* for skill and *C* for chance."

It really looks as if the chap who isn't a B.Sc. hasn't a look-in! "F. M. D." reaches the top of his form in the following tremendous effort:—

> "Analysis of individual cases shows that the elements which count in personality are: Power-factor (which Professor Ayrton used to define as the 'ratio of real to apparent truth'), Capacity, Intensity, Intrinsic Brilliancy, Self-induction, Frequency, Resistance, Permeability, Reluctance, Mutual Induction, Time Constant, Resonance, Ability to carry overload without smoking, Ability to keep in step when working in parallel with others of different type, and finally, Retentivity and Coercive Force."

This is the climax to "F. M. D.'s" article. He can write no more; the fount of inspiration is dry. I feel I can adequately revenge myself only by the following pathetic composition:—

MY JOB!

There was a time (but long ago)
When my age was—well, so-and-so,
And being young, with lots of cheek,
I wrote about a job each week.

The weeks went by, the years went too;
And Ma at last got in a stew.
Said she: "You might as well give up,
And stop at home and mind the pup."

I said "Right-O!" and ever since,
I've stayed at home just like a prince.
But don't think my job's all a spree—
The pup's a granny now, you see.

Sometimes I dream of long ago,
When my age was—well, so-and-so,
And being young, with lots of cheek,
I wrote about a job each week.

ELEKTRON.

Finance.—The gross profit of the British Electric Traction Co., Ltd., for the year ended March 31, 1924, amounts to £278,066, and, after making ample allowances for reserve, etc., the directors are able to declare a dividend equivalent to 6 per cent. per annum on the ordinary stock.

Southern Railway Electrification.—Messrs. Henley's Co., Ltd., have received the order from the Southern Ry. Co. for the electrification of their South Western Suburban Lines between Raynes Park, Epsom, Leatherhead, Effingham Junction, Clandon, Guildford, Dorking, Hampton Court and Oxshott. The total length of cable involved amounts to more than 60 miles, and the cables are .2 deg. in., .15 deg in., .1 deg. in., .06 deg. in Extra High Tension 3-core, paper insulated, lead-covered and single wire armoured for a working pressure of 11,000 volts. Other important contracts which this company has carried out in connection with railway electrification are:—L. and N.W.Ry. (over 20 miles), Central Argentine Ry. (approx. 42 miles), Buenos Ayres Western Ry. (approx. 78 miles), and the L. and Y.Ry. (13,000 yards). Evidently the British cable-making industry is in a fairly healthy condition.

ELECTRIC DRIVING OF A MODERN FACTORY.*

BY F. W. SMITH, N.A.S.E.

(Concluded from page 286.)

TORQUE CAPACITY.

The torque required to start up a press from rest varies, but it rarely, if ever, exceeds 2½ times running torque.

If the main motor were a constant-speed motor the field would be of constant strength, so that in order to exert 2½ times full load torque, the armature would require 2½ times full load current. The main motor of the "Gem" system, however, is at least 2-1 speed range, so that with full field strength only full load current is required for twice full load torque. In addition the motor is fitted with high density starting turns and series windings, the resultant being that three times full load torque is obtained with only full load current, but in order that there cannot under any safe condition be a stall, the motor generator is designed to give twice full load current, and consequently six times normal torque is available, and, as a matter of fact, the capacity for torque is only limited by the overload circuit-breaker, or the burning out of the armatures. The dynamo being dead shorted across the armature of main motor, this is only possible because the dynamo is self-regulating. The fault of old sets was often due to insertion of resistance in this circuit to cope with varying load of press, but this problem has been safely overcome, and resistances are not used.

The motor generator is only used for inching and trawling. When this is finished, the motor is coupled to the mains through armature resistances, and these are cut out in the usual manner, and thereafter shunt resistance is inserted in the field. Precautions are taken so that the change over from one supply to another is without the suspicion of a jerk—this is simply a matter of resistance proportions. The motor generator automatically shuts down when main motor is connected to line, and automatically starts up when the motor reaches a predetermined slow speed due to retardation button being used.

ECONOMY.

The percentage of working time on a press averages 50 per cent. making ready and 50 per cent. printing. A 50 h.p. equipment will take from the line about 5 units on inching speeds.

AUTOMATIC CONTROLLER.

The automatic controller consists of slate panel mounted on angle-iron stand, and is enclosed with iron housing with hinged glass doors, and contains d.p. main switch, main and inching contactors, magnetic blow-outs, automatic direction switches, overload circuit-breakers for inching and running.

METHOD OF OPERATION.

When the main switch is closed the main contactor is energised, and the motor generator starts up. Pressure on the inch button allows a low-voltage current to flow to the main motor, giving instantaneous torque on the press. The press continues to run until the inch button is released. The creep speed can be adjusted on site to suit the actual speed required by the press.

---

* Lecture delivered before the N.A.S.E.

Pressure on the run button brings the motor up to any desired speed, and by pressing the retard button the speed is brought back to the creep.

The motor generator is cut out of circuit when the run button is pressed, and is only brought into use again when the creep speed or inch is required.

The controller is operated from master control stations, consisting of "inch," "creep" "run up," "run down," "stop," "safe," and around the press are fixed emergency "stop" buttons, which, when operated, stop the press irrespective of the speed at which it is running, and at the same time locks the press, so that it is impossible to start the press until the "safe" button is released.

I have reluctantly found it necessary to omit several subjects which come more or less within the scope of this paper, among them being: The supply, wiring, distribution, measurements and protection, and each of these subjects really requires a paper to itself for adequate treatment, for the many and various problems involved in the design and installation of cable lay-out in factories are not always appreciated by the consumer, and it is for this reason that I think these subjects should be dealt with separately.

In conclusion, I have to express my thanks to Messrs. Witton James, Ltd., Laurence Scott and Co., and Electromotors, Ltd., for the loan of lantern slides, and for the courteous manner in which they have assisted in the article dealing with rotary driving. It would be a discourteous act on my part were I to criticise any of these methods of control, and I would add that the best possible feeling exists between the various manufacturers of this class of work, and I am sure you will all agree that this is to the benefit of the electrical industry, and the world at large, while there is enough work in it for us all if we only try hard enough to get it.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION No. 182.

In the event of a 20 h.p. d.c. motor failing through no apparent cause, what tests should be carried out to locate the defect? State the tests in their correct order.—A. N. BUTLER (Wolverhampton).

QUESTION No. 183.

I have an intermittent rating motor starter of 50 h.p., 440 volts, 50 cycles. This starter is contained in a cast iron case which is filled with oil. From tests I have carried out I find that an open circuit exists between two contacts. How can I best remedy this defect? What precautions should I take with regard to the oil, etc.?—"ASTATIC."

(*Replies to Questions Nos.* 182 *and* 183 *must be received not later than June* 28, 1924.)

TELEGRAPHY.*

Being solutions to the questions set at the Grade I. examination in Telegraphy held by the City and Guilds of London Institute, on April 30, 1924.

Q.—Describe, with a sketch, the construction of a Leclanché cell. State its chemical action.

A.—The Leclanché cell (Fig. 1) is made by pouring into a glass jar a solution of sal ammoniac (NH_4Cl). A zinc rod into which a tinned copper wire has been cast is placed in the liquid. A porous pot of unglazed earthenware, and containing a plate of carbon (C) surrounded by a mixture of coarse powdered gas carbon, or coke, and peroxide of manganese (MnO_2), is then placed in the solution. The top of the porous pot is sealed with bitumen, two small air-holes being left therein for the escape of gases. The top of the carbon plate is covered with lead, which is not liable to be eaten away, as brass would, by the ammonia gas which is evolved when the battery is in action. A brass binding screw is fitted on to this lead cap, and this serves as an attachment for the zinc rod of the next cell. The top of the zinc rod and the lead cap of the carbon plate are coated with marine glue to protect them from the action of evolved gases. When the battery is in action the zinc is dissolved and zinc chloride ($ZnCl_2$) is formed, and some other salts of zinc which are only soluble in sal ammoniac and water. The peroxide of manganese is reduced to a lower oxide (the sesquioxide), and ammonia gas (NH_3) is given off. Water (H_2O) is also formed.

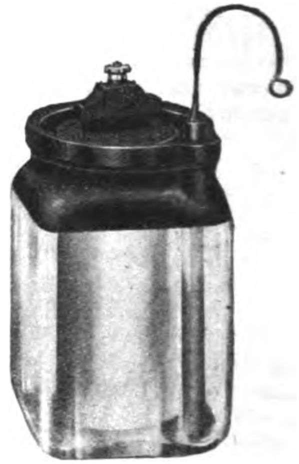


FIG. 1.

The chemical action may be stated symbolically thus:—

Before contact:

$$Zn + 2NH_4Cl + 2MnO_2 + C.$$

After contact:

$$ZnCl_2 + 2HN_3 + H_2O + Mn_2O_3 + C.$$

The electromotive force is 1.5 volts, and the resistance is about 3 ohms.

The most recent form of Leclanché cell used by the British Post Office differs from the ordinary form described above in that two zinc rods of the peculiar

---

* Books recommended are:—*Questions and Solutions in Telegraphy and Telephony, Grade I.*, by Few (Rentell, 5s. 10d., post free), and *The Telegraphists' Guide*, by Bell and Wilson (Rentell, 3s. 10d., post free).

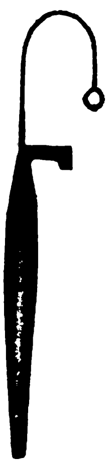


FIG. 2.

shape shown in Fig. 2 replace the cylindrical rod, and are hung in the containing jar on opposite sides of the porous pot, and finely powdered manganese dioxide is employed as the depolariser instead of pebble manganese dioxide. The employment of the former results in the speedier oxidation of the free hydrogen, thus reducing polarisation to a minimum. These modifications result in a greatly increased. output, and therefore reduce the cost per ampere-hour; the cell has greater constancy, and the cost of maintenance is consequently less.

It should be mentioned that the ammonia gas given off by the cell exercises an injurious effect on metals and also on secondary cells which may be in the near neighbourhood. To obviate this, manganese chloride ($MnCl_2$) is employed as the excitant instead of the sal ammoniac solution, and the chemical action then is :—

Before contact :

$$Zn + MnCl_2 + 3(MnO_2).$$

After contact :

$$ZnCl_2 + 2\,(Mn_2O_3).$$

It will be seen that no gas is liberated, and, therefore, such cells can be accommodated in secondary battery rooms; also, no protection of connecting wires is necessary.

The electromotive force of the modified form of cell is 1.5 volts, and the resistance is less than an ohm.

(To be continued.)

THE G.E.C. ENGINEERING BULLETINS.

This noted firm, which is representative of the leading features of British pioneering efforts and practical developments in electrical engineering in this country, has recently issued several striking publications combining catalogue information with highly important technical literature, which call for rather more than ordinary notice. They are issued as "Bulletins," a distinctive title adopted by this firm, and have been primarily prepared as connected with the British Empire Exhibition, but are obtainable by any engineers who may be interested, and who desire to be up-to-date and fully informed as to the possibilities of obtaining high-class equipment to meet the requirements of modern expansion of engineering and electrical development.

The exhibit of this firm at Wembley practically demonstrates, and the illustrated and literary descriptive matter in these volumes, give most convincing testimony to the marvellous resources of the General Electric Company where heavy and powerful plant is concerned. Thus in the first volume, issued as "Bulletin No. 1," and concerned with "Heavy Electrical and Mechanical Plant," there are photographic reproductions of turbo-alternators, blowers and compressors, D.C. generators, rotary convertors, steam and electric winding engines, and other colliery plant, factory equipment, conveying and materials handling plant, controlling and starting gear, circuit breakers, etc.

"Bulletin 13" is more definitely descriptive of "Turbo plant," and has many diagrammatic drawings facilitating the quick understanding of design and purpose of the special constructive features of the machines and their application. Their "Bulletin No. 17" deals with "Steam and Electric Winding Engines," and the technical information and diagrams given are exceedingly valuable and instructive, especially to mining and colliery engineers, and show the unique position held by the G. E. Co. and their associated firms in connection with this class of work, a position only to be attained by many years of practical experience in construction and application.

Bulletin No. 18" has to do with materials handling plant, and concerns chiefly the Fraser and Chalmers' engineering works branch of the firm, and describes most lucidly by way of illustration and descriptive matter the range of apparata, cranes, grabs, conveyors, belts, tipplers, etc., manufactured by the company, as well as their application, and shows also the wide experience the firm has had in the variety of installations of such plant.

"Bulletin No. 19" has to do with concentration machinery, and is especially interesting to those dealing with ores and minerals and their separation. It gives most varied and valuable information concerning stamp mills, crushers, separators, screens, selecting and concentrating apparatus, and the attendant details, and is full of illustrated descriptive matter.

In addition to the above "Bulletins," three catalogues are also issued dealing with (1) D.C. motors, (2) A.C. motors, and (3) transformers, which not only give the ordinary details usual in such issues, but also, in the case of the motors, give particulars of approximate powers required to give different types of machinery and other useful information, embracing a wide range of different tools and machines, and which add to their usefulness to the technical as well as to the commercial engineer. The production and general "get-up" of these publications bear testimony that the publicity department of the company share in the general excellence of its organisation and its productions.

NEW MULLARD VALVES.

The Mullard Radio Valve Co., Ltd., the makers of the well-known "Ora" wireless valves, send us a pamphlet—list No. V.A.3—descriptive of a new series of low-temperature filament amplifying valves, for which they claim special advantages, both in amplification capacity and in the purity of tone in reproduction, as well as exceptional economy in current consumption and long life. They are known as the series D.F.A., and the list gives very complete data of their working characteristics. There are three lamps in the series, numbered as 0, 1 and 2, and any of our wireless readers interested should write to the Mullard Valve Co., Ltd., Nightingale Lane, Balham, London, S.W.12, and ask for the above-mentioned list.

We hope to have an opportunity ourselves of trying the virtues of one of these lamps before long.

Situations Vacant.—The Sudan Government Railways require the services of an electrical foreman. For particulars, see advert. in the prepaid page.

THE STORY OF A WIRELESS HOAX.

By George E. Moore.

(Copyrighted by G. E. Moore in U.S.A.)

A Plot is Plotted.

If Mr. and Mrs. Jardine hadn't been coming on the following Saturday I don't think the plot would ever have been hatched. I must explain right away that *Mr.* J. is a crystal-set fanatic. Now, *we* have a crystal set, but it boasts a one-valve amplifier and loud-speaker; and somehow or other it was agreed that it was only right and proper (indeed, an act of justice) that Mr. J. should "have his leg pulled."

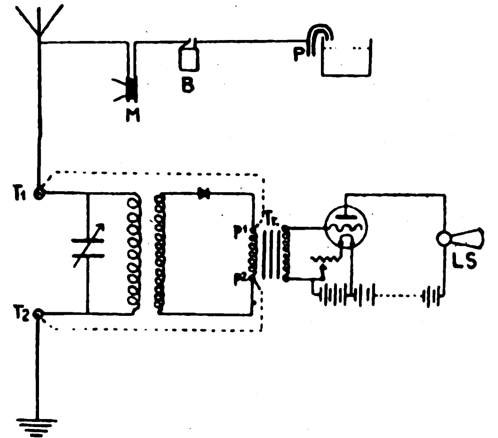
Now, I happen to be the local wireless expert. This is partly because I'm in the Institution of Electrical Engineers, but the real reason is that although I know next to nothing about radio, up to the present there is nobody else knows as much. And so, when by general consent it was decreed that a hoax should be sprung on Mr. J., it was to me that all eyes turned, and behold! I became chief conspirator.

Well, I must have been in unusual form, for a brilliant idea suddenly came into my mind. *Why not, with the aid of a microphone in the attic connected to the wireless set downstairs, give Mr. and Mrs. J. a special concert and add some particularly special and personal announcements?* This was carried *nem. con.*

Technical Details of the Plot.

Partly for reasons of technical wisdom, but mainly to give no cause for suspicion on the part of the victims, I did not rig up any complicated wiring. So far as the guests, or, indeed, anybody, could see, everything was "as per usual." The only special connections were inside the set and away up in the attic.

First, let me describe the receiving set as it really is when behaving itself. Outside on the roof there is a single-span aerial 60 ft. in length, stretching from one chimney stack to another two houses away. The 30 ft. lead-in drops sheer down from the attic to the ground floor. "Earth" is a solid connection to a water-pipe in the kitchen.



The set itself is a simple one (*vide* diagram), the reception being viâ a loose-coupling tuned on the aerial side, crystal, and one-valve amplification to loud-speaker. This circuit in one form or another is very well known. The *special connections* for the hoax are shown by dotted lines in the figure; these were made inside the set, the condenser, two inductances and the crystal being cut out for the time being. Externally the aerial and earth terminals, T_1 and T_2, were connected up as normally, but *inside*, the primary (P_1P_2) of the L.F. transformer was across them. Short of an expert examination of the internal wiring there was nothing in the appearance of the set to raise suspicions.

Now, as to the "concert room" aloft. An old telephone set, minus the receiver, but still bearing its transmitter, was mounted on the wall of the attic; one could arrange it for conveniently speaking into or for disposing in front of a gramophone. The microphone transmitter, *M*, was connected on the one side to the aerial lead-in, and on the other through a flash-lamp battery, *B*, to the feed-pipe, *P*, of the cistern. The gramophone, I should add, was minus its horn.

The result of all these connections was that the current variations set up by sound affecting the microphone diaphragm could flow in a completed circuit—lead-in, primary of L.F. transformer, earth, feed-pipe of cistern and thence to attic. The pulsating current to the transformer was amplified by the valve circuit, and so the loud-speaker reproduced the sounds made in the attic.

Stage Directions.

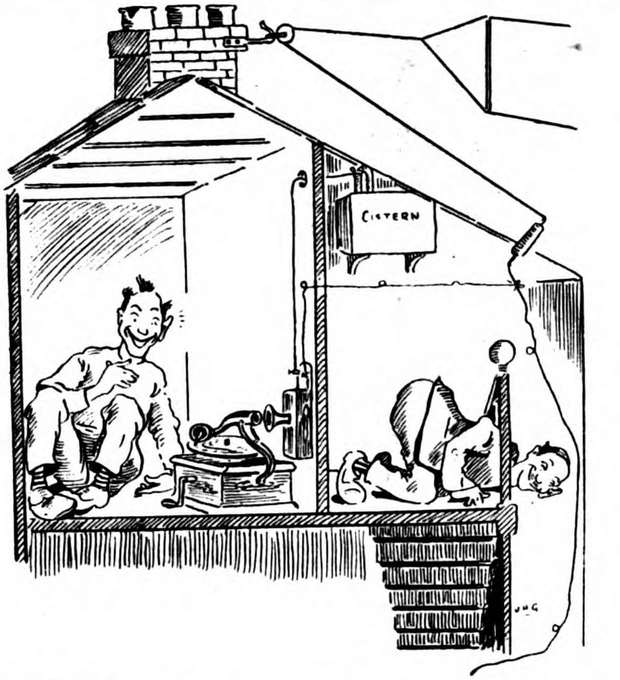
There are just a few other details to tell you. On the ground floor the comedy was enacted in two rooms—the dining-room and the drawing-room; whilst the conspirators worked two floors above in the attic. In each of the two rooms there are provided aerial and earth terminals, so that the set can be rigged up in either quite easily. You must also make mental notes to the effect that Mr. and Mrs. J. live three miles away on the other side of the river; and that Mr. J. has two other vices besides his battery of crystal-sets—he *smokes* and he *golfs*.

Now as to what we arranged to do on Saturday evening: Conspirators missing. During tea, the afternoon concert from the local broadcasting station entertains the visitors. After tea they retire to the drawing-room, leaving the set behind. The conspirators now quietly enter the house, the *internal* connections of the set are altered, and they mount to the "concert-room." In the drawing-room it is suggested that the "wireless" should be brought in, and this is done—Mr. J., *of course*, lending a hand.

A Disastrous Start-off.

Behold now the two conspirators, who had better have the titles of Engineer and Station Director (myself) and Assistant Station Director, arriving at the fateful hour on Saturday when Mr. and Mrs. J., having partaken of tea, were supposed to be in the drawing-room. A whispered greeting from an accomplice explained that the plans were "ganging agley." *Mr.* J., unfortunately, had refused to leave the set and was sitting there with the 'phones glued on. Worse, he was suddenly heard enquiring as to the new arrival(s)!

There was nothing else for it but for the Assistant Station Director to go in and be introduced, while the Engineer Director crept quietly upstairs. About ten minutes later the A.S.D. appeared and announced that at last, with the greatest difficulty, Mr. J. had been persuaded to join his wife in the drawing-room For the sake of appearances, I told the A.S.D. to help entertain the party (I heard afterwards that his mental



worry was such that he kept in the background) while I altered the internal wiring of the set.

This done (after one or two false alarms), I returned to the attic, where presently the assistant joined me for further instructions. As no suspicions must be raised, I told him to make an excuse for leaving the house and to give the front door an extra-special bang; he could then re-join me. But he was so flurried that at first he couldn't see the point, for he thought he had to *really leave the house*.

At long last I heard the street door close with a bang that shook the house, and the Assistant had hardly returned to the attic looking more worried than ever

than there was a babel of voices below. Mr. J. could plainly be heard taking a prominent part in the transport of the set, and then fussing about with the external connections.

I started-up the gramophone (first item: "Washington Grey's March") and we had at last begun.

THE HOAX.

I sent the Assistant Station Director (minus his boots) downstairs to listen. He came back with a favourable report, cold feet, and what he suspected to be a *tack*. "Washington Grey's March" over, the Assistant (visibly trembling) announced that the regular concert was "off," but that the new studio gramophone was filling the breach. Another record was put on, and below Mr. and Mrs. J. had an argument as to whether or not the announcer was a newcomer to the local broadcasting station. The "not" (Mr. J.) lost.

The next item was "Mr. George Edwards, the well-known imitator with some of his well-known imitations." You will see that the announcer's excitement was limiting his vocabulary. Mr. George Edwards was no less a person than myself, so that you see I filled the rôles of engineer, director and artiste! I gave a series of imitations which I had inflicted on many audiences at concerts.

Then came these dramatic announcements:—

> "The Government are determined to increase the tax on tobacco." (Mr. J. nearly drops his pipe.) "Further, expensive sports like hunting and golfing are to be heavily penalised." (Mr. J.'s amazement and indignation beyond measure.)
>
> "Owing to a subsidence in the river-bed the main bridge is closed to traffic, and all traffic must go *viâ* another bridge several miles up river." (Mr. and Mrs. J., who must needs cross the river, are completely taken aback, and discuss the chance of hiring a boat.) They are silenced by:— "
>
> "Will Mr. Jardine, whose house has been burgled, please call immediately at the Police Station." (Complete collapse of Mr. and Mrs. J.)
>
> "The Broadcasting Station will now close down for just a couple of hours, while the engineer makes some adjustments."

Even this didn't make Mr. and Mrs. J. "smell a rat." Under the shock of the burglary Mrs. J. remained fairly cool; Mr. J. was more staggered, and after thanking his lucky stars that he had all their money with him, he rose to make his way to the Police Station.

A burst of laughter was followed by the appearance of the Engineer-Director-Artiste and the Assistant Station Director, and then it began to dawn upon Mr. and Mrs. J. that *somehow* a joke had been played on them.

BEFORE CLOSING DOWN—

The conspirators wish to make the following *true* announcements:—

> Great relief that Mr. and Mrs. J. are "sports," and (as regards the Assistant Station Director) that the whole thing is over;
>
> A solemn warning from Mr. J. to "look-out";
>
> The fact that for some time afterwards it was thought that the announcements were the only faked part; and
>
> The astonishment when it was realised that "Mr. George Edwards" was there before them in the flesh!

ADIEU, BUT NOT FAREWELL.

On Friday, May 30, Mr. E. Garcke presided over a happy gathering of over fifty gentlemen who, as guests of the Electrical Press, Ltd., had been invited to join with the directors in wishing good luck and prosperity to Mr. Adam Gowans Whyte on his new post as assistant to Mr. H. E. Blain in the Conservative Party organisation. During his twenty-three years as editor of our contemporary, *Electrical Industries*, Mr. Whyte has made a host of friends, and the tone of the speeches which followed the dinner at the Connaught Rooms left no doubt as to the high esteem in which "Adam" is held by his friends in journalism, as well as by all in the industry. The toast of the evening was ably proposed by Mr. Garcke, supported by Mr. Blain, and it was accompanied by the presentation to Mr. Whyte of a gold watch, suitably engraved, and to Mrs. Whyte of a handsome handbag. Mr. Whyte's reply was thoroughly apropos, and he made us all feel that, although he was forsaking the electrical world for the time being, yet, on the other hand, he was not at all likely to forget his old friends of so many years. He touched most feelingly on his associations with Mr. Garcke, Mr. Madgen and Mr. Alderson Smith, and said he felt certain Mr. Randell would be well able to carry on the editorial work, in which he had already given proof of much ability. In addition, he referred to the veteran, Geo. Offor, and then went on to express sympathy with the *boná fide* electrical trade journals in the unfair competition which they had to meet in the way of subsidised and, in a sense, parasitic organs, closing finally with graceful thanks for the way in which he had been treated by his directors and the many friends around him. Mr. Atkinson followed with some very kindly remarks about the electrical Press, to which acknowledgments were rendered by Messrs. Allen, Masters, Hughman, Rentell and Randell, with Mr. Warrilow saying a few words on behalf of the advertisers; and then Mr. T. C. Elder proposed a vote of thanks to Mr. Garcke, who repeated what a pleasure it had been to preside at the dinner.

Various Items.

Congratulations to Mr. R. A. Dalzell, C.B.E., director of Telegraphs and Telephones at the G.P.O., on the C.B. which has been conferred on him in the Birthday Honours list.

Burnley.—The Electricity Commissioners have decided to consent to the establishment by the Lancashire E. P. Co. of the proposed generating station at Padiham, subject to certain conditions, and to refuse consent to the establishment by the Corporation of Burnley of a generating station at Simonstone.

"**The Motor Ship**."—The current issue of this very enterprising paper contains some articles of direct interest to electrical engineers, including an important lecture on the subject of transmission losses in Diesel electric systems, as well as an account of the twin screw motor yacht *Nimet Allah*, in which there is an excellent electric lighting installation

Finance.—The report of the Iron Trades Employers' Insurance Assocn., Ltd., for the year 1923 shows a very healthy profit, and, after allocating £2,000 for distribution among hospitals which render service to the company, it has been decided to make a return at the rate of 15 per cent. of the Workmen's Compensation Premium to the present policy holders of the Association who are entitled thereto.

Films at Wembley.—Filmit, Ltd., of 12, Charing Cross Road, W.C.2, are now giving daily a free display of industry and technical films in their theatre in Avenue 14, Bay 16, of the Palace of Engineering, and we can cordially recommend our readers to visit these displays, as they are really of direct interest to many of them, dealing as they do with the manufacture of all sorts of engineering and electrical appliances.

Swedish Industries Fair.—Gothenburg, whose Jubilee Exhibition last year won world-wide admiration, will this year again be the scene of a Swedish Industries Fair, at which all branches of Swedish industry will be fully represented. In addition to staple products, the main groups of exhibits include machinery and tools, metal products, electrical apparatus and machinery, scientific instruments, chemicals, etc. The Fair will be open from August 4 to 10.

Quotations Wanted.—The Municipal Council of Johannesburg is calling for tenders for the supply and delivery of electric lamps and watertight fittings for street lighting.——The Management of the State Electricity Supply Works at Montevideo invite tenders for 82,000 metres of V.I.R. wire and cable.——The Municipal Council of Sydney, N.S.W., invite tenders to be presented for A.C. and D.C. Consumers' Meters. Specifications, etc., at the D.O.T. (Room 52), 35, Old Queen Street, London, S.W.1.

Crystal Palace School of Practical Engineering.—After nearly twenty-six years as Vice-Principal of this old-established school, and a like period as Principal, Mr. J. W. Wilson, M.Inst.C.E., M.I.Mech.E., Past-President of the Society of Engineers, is announcing his retirement at the close of the present term. He will be succeeded in the Principalship by his brother, Mr. Maurice Wilson, A.M.Inst.C.E., F.S.E., Past-President of the Society of Engineers, who has been the Vice-Principal for the past twenty-six years. It will be remembered that this school was founded by Mr. Wilson, sen., in the year 1872, since which time over 1,300 students have succeeded in the profession, many of whom occupy high positions therein at the present time.

Automatic Telephones for Japan.—The contract for the reconstruction of the Tokyo Telephone System, which was utterly destroyed in the recent earthquake, has been awarded to the Nippon Electric Co., Ltd., of Tokyo, an associate company of the Western Electric Co. The entire system is to be of the Strowger Automatic Type, and will be manufactured in England jointly by the Western Electric Co., of London, and the Automatic Telephone Mfg. Co., of Liverpool. The initial order covers an equipment of 25,000 subscribers' lines to be installed in five offices, with trunking equipment in two other offices to enable the subscribers on the new Automatic exchanges to reach the subscribers on the remaining existing Manual exchanges. The value of the initial contract now placed is about three-quarters of a million sterling, and the entire reconstruction programme will involve the building of about twenty-five new exchanges in due course.

Trade Notes.

The June price list of the **Siemens and English Electric Lamp Co., Ltd.**, of 39, Upper Thames Street, London, E.C.4, has just been issued by the company, and in view of the improvements of the weather, the details given with regard to their special lines in electric fans should prove useful for retail dealers and contractors generally.

Three new catalogues have just been issued by the **Edison Swan Electrical Co., Ltd.** They deal respectively with A.C. motors, instrument meters and switchgear, and accumulators and house lighting sets. In each case they are well illustrated with diagrams and technical details, as well as giving full particulars of the advantages claimed for the instruments, accumulators or meters as the case may be, and as such they should appeal to all electrical engineers and contractors, to whom they will be sent on receipt of proper trade application.

Cards illustrating several of the Monitor Patent Safety Devices for air compressors, gas engines, electrical plant, etc., have just been issued by **Mr. C. L. Stokoe**, of Laburnum Avenue, Wallsend-on-Tyne, and should prove of interest to central station engineers, and men in charge of steam plant generally. Several of the devices have been fitted to power plant at the British Empire Exhibition.

ARMATURE REPAIRS
MARRYAT & PLACE.
28, HATTON GARDEN.
LONDON E.C 1

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

JUNE 13, 1924.

CONTENTS. PAGE

Variable Speed A.C. Commutator Motors 303
Restaurant Lighting 304
The Illumination of the B.T.-H. Stand at Wembley 305
Kelvin Centenary Celebrations 305
Cinema Lighting 306
Current Topics 309
About this Power-Factor 310
Telegraphy 312
Questions and Answers by Practical Men 312
The Engineering Representative 312
Reviews of Books.. 313
Trade Notes 314
Various Items 314

VARIABLE SPEED A.C. COMMUTATOR MOTORS.*

By H. Dreghorn, B.Sc.

The alternating current system is now the more popular, and generally new developments usually adopt this system. This is due to the ease of generating, transmitting and distributing A.C. power, and also to the simplicity and robustness of the ordinary induction motor. Where speed variation has been necessary, this has usually been obtained by using D.C. motors, but more recently means of obtaining this in A.C. machines have been developed. The induction motor is essentially a constant speed machine, but various speeds can be obtained by changing the number of poles, by cascade connections, or by inserting resistances in the rotor circuit. The first two methods give speeds very limited in number, whilst the third gives inefficient working, speed characteristics of series wound machines, and also limited number of speeds.

Series Commutator Motor.

The alternating current commutator motor was devised by Georges in 1891, but was not developed till much later, due to commutation troubles, but now this phenomenon is better understood, and many motors are now in successful operation. The stator of this motor is similar in construction to the stator of an ordinary induction motor, and the armature resembles that of a direct current motor, the commutator generally having larger dimensions than that of a direct current motor of the same rating. One end of the stator phases is connected to the supply and the other to the brush studs, so that stator and rotor are connected in series. However, in order to improve the commutating conditions, it is usual to interpose a transformer between the stator and rotor, so that it is possible to wind the stator for use on a high voltage system and still have the necessarily low voltage on the armature and commutator. For all supply voltages above 200 the transformer becomes necessary, but is of small dimensions, as the capacity of this transformer is only a fraction of the output of the motor since it only deals with the slip power.

The axis of the motor M.M.F. with reference to the stator M.M.F. can be rotated through 180 deg., and the resultant of these two M.M.F.s produces the flux of the machine, which will, therefore, vary with the position of the brushes as well as with the current flowing in the windings. The rotating field induces in the stator winding an E.M.F. proportional to the frequency, the number of turns and the flux, and also in the rotor winding an E.M.F. proportional to the number of turns and the flux, but this also depends on the speed. At standstill, this E.M.F. will be maximum and at synchronism zero. The direction of rotation is independent of the phase rotation, but better characteristics and operation are obtained with the direction of rotation the same as the phase rotation. The other voltage of the motor is the impedance voltage, which is almost entirely proportional to the current except for a small proportion which depends on the speed.

The speed of the motor is, therefore, fixed by the following considerations :—

The flux is fixed by the current and the angle between the M.M.F.s, and so the E.M.F. induced in the stator is fixed. Adding to this the impedance drop, it is found that except at synchronous speed another E.M.F. is required to give a total resultant equal to the applied E.M.F. This E.M.F. is supplied by the rotor, which will rotate at the particular speed necessary to produce it. At synchronism this will be zero, and at other speeds its magnitude will determine the amount of speed above or below synchronism, while its direction will determine whether the speed is above or below the synchronous speed. By altering the brush position then speed variation is possible.

It is evident that at small loads the flux will be low since the current is low, and therefore the speed will rise to a high value as the rotor will require to produce a high voltage to effect a voltage balance. Also the speed will undergo large changes with changes of load. Here again, the transformer between the stator and rotor is advantageous, for by arranging that the iron of the transformer becomes saturated when the transformer supplies a large voltage, the flux of the motor will be increased, since the magnetising current of the transformer circulates in the stator winding, and so the light running speed of the motor is prevented from reaching a dangerously high value. It is usual to design the transformer so that a light running speed 50 per cent. above synchronism is the maximum obtainable. The light running speed can also be limited by reducing the number of turns of this transformer, for which purpose it is usual to provide a lower tap on the winding.

The speed torque curves resemble those of an induction motor with secondary resistances, except that the light running speeds exceed the synchronous speed. The curves are much flatter at light loads, which shows that care must be exercised in selecting a motor not too large for the duty. Over-motoring, generally undesirable, becomes objectionable with series motors. Machines for low frequency are easier to build than those for high frequency, and the upper limit of capacity of 25-cycle machines is about 150 h.p., and of 50-cycle machines 100 h.p. At low speeds the motor becomes unstable, which influences the extent of the speed range possible. Usually, with constant torque, a speed range of 3/1 is the utmost possible. By connecting both motor and transformer in delta when running at high speeds, and in Y when running at low speeds, the stability at low speeds can be increased.

---

* Paper read recently before the Birmingham and District Electric Club.

While all speeds within the range can be obtained, the drawback of this machine is its series characteristic. However, where the torque at any speed is constant, this motor is quite suitable, and has been used successfully in such applications as driving centrifugal pumps, blowers and ventilating fans.

Eichberg 3-phase Shunt Commutator Motor.

One of the earlier types of variable speed A.C. commutator motor with shunt speed characteristics is the Eichberg motor.

This motor consists of a stator similar to that of the ordinary induction motor, and an armature similar to that of a direct-current machine. The stator is connected to the supply, to which is also connected the primary of a transformer. The armature of the motor is connected to the secondary of this transformer, which is arranged with a number of tappings on each phase, and so the voltage impressed on the armature can be caried at will. Power-factor improvement can be produced by connecting in each phase a coil from another phase. This transformer can be eliminated by using the stator winding as such, and the power-factor improvement can be obtained by closing the star point of the stator winding through a polygon, so that a voltage out of phase from the true star voltage of the supply is impressed on the armature.

In order to describe the action of the machine let us consider a 3-phase, 2-pole motor. The stator winding will produce a rotating field which will travel round the machine at the frequency of the supply. At standstill this flux will cut the armature winding at maximum speed and induce in it a voltage depending on the frequency, the magnitude of the flux and the number of turns in the winding. If, however, the rotor were turned in the same direction as the rotating field, the frequency of the cutting will be reduced and hence a proportionately lower voltage will exist between the brushes. The frequency of the voltage in the winding will be lower, but as the brushes remain stationary the frequency on the brushes will still be the full frequency of the supply. The voltage appearing at the brushes would, therefore, be a maximum at standstill, zero at synchronism, and a value at twice synchronous speed equal to the standstill value but opposite in sign. The current in the armature will be produced by the resultant voltage existing in the winding. Now if the brushes are connected to the transformer, a definite voltage would be impressed by the transformer on the brushes, and on light load the motor speed would be such that the voltage induced by rotation would be practically equal to this impressed value. As the load is applied, current must appear in the armature winding, which with the stator flux will produce the necessary torque, and the motor would have to slow down slightly so that the induced voltage would exceed that impressed by the amount required to force the necessary current through the impedance of the circuit. The impedance voltage is very small indeed, and so only small changes in speed result from load. It is, therefore, evident that speed variation can be produced by impressing different voltages on the brushes by altering the transformer tappings. By continuing the stator winding beyond the star point, speeds above synchronism can be obtained, as the direction of the impressed voltage must now be in the opposite direction from hitherto.

While this machine has the speed characteristics of a shunt wound D.C. motor, the number of speeds is very limited, depending on the number of points on the controller.

(To be continued.)

RESTAURANT LIGHTING.

The Victoria Mansions Restaurants, 24, Victoria Street, S.W., is well known to many electrical men who have attended Batti Wallah concerts and similar functions, and by the courtesy of the proprietors, we now reproduce a photograph showing the lighting installation which has recently been reorganised.

On the lower floor, which is shown in our illustration, the ceiling fittings consist of 18 in. panelled silk bowls, and on the walls, 3-light Jacobean candle brackets finished bronze colour, screened by hall-circular silk shades to match the silk bowls. In the entrance corridor are three 14 in. cut glass ceiling bowl fittings and one 10 in. cut glass bowl fitting. The restaurant on the entrace floor has 14 in. panelled silk bowl ceiling fittings, and on each table 9 in. table standards with silk domed shades, each fitted with three English cut glass flower vases.

On the first floor is an American bar, and from the ceiling are suspended 21 in. panelled silk bowls, and fixed to the walls are 3-light candle brackets of Adams design finished dull gold. The ceiling fittings are equipped with 200-watt Siemens gas-filled lamps, 60-watt Siemens vacuum lamps are used for lighting the table standards, and 20-watt Siemens candle lamps in the wall brackets.

All the electric light fittings were specially selected and the installation was carried out by Messrs. F. G. Edey and Co., 25 Warwick Lane, E.C.4. The effect at night is very pleasing, as the design of the electric light fittings harmonises with the decorative scheme in each room, giving an air of inviting comfort.

THE ILLUMINATION OF THE B.T.-H. STAND AT WEMBLEY.

A good deal has been heard of the wonderful lighting effects at the British Empire Exhibition, although the illumination of the grounds and lake was not then in full operation, and many of the comments which have appeared in the non-technical Press must have been written up by journalists endowed with the prophetic instinct. There are, however, some excellent examples of lighting in the various pavilions. So far as individual firms are concerned praise must undoubtedly be given to the British Thomson-Houston Company, whose stand in the Palace of Engineering is lighted in a manner which is at once spectacular and unusually beautiful. Of course, the British Thomson-Houston Company have had a great deal of experience in this connection, and one would naturally expect the lighting of their stand to be considerably above the average. This, however, is not the only reason for the outstanding excellence of the illumination. The success achieved is very largely due to the fact that the lighting of the stand was planned at the same time as the stand itself, and was actually worked out in collaboration with the architects who designed the stand. As a result, although the lighting is spectacular, it is none the less an integral part of the *tout ensemble.*

DIFFICULTIES ENCOUNTERED.

A great deal of skill and thought were required in the lay-out of the stand and the lighting in order to ensure a well-balanced and dignified display, owing to the variety and disparity in size of the exhibits, which range from a pea lamp to a turbine. The space occupied by the stand consists of two rectangles, each measuring 86 ft. by 33 ft., with a 10 ft. gangway dividing the two sections. The large size of some of the machines exhibited made it necessary that the greater part of the stand should be of the open platform type, while provision also had to be made for displays of lamps, lighting equipment and radio sets. The gangway referred to is a public thoroughfare, and is not a portion of the stand space. It was, therefore, somewhat of a problem to design a layout which, without encroaching on the gangway, should unite the two rectangular sections in a homogeneous scheme. This was accomplished by forming a kind of circular court in the centre of the stand.

LIGHTING THE OPEN STAND.

The illumination of open stands is not an easy matter, especially when the roof is inaccessible. In this case the problem was solved by the use of specially designed standards fixed around the outside of the stand. They were designed for this particular purpose, and were manufactured at the B.T.-H. Fittings Factory, Rugby. At the top of each standard is fixed a kind of rectangular box sign, which is open at the bottom. This sign contains eight 60-watt white Mazda lamps. At night the light from these lamps is reflected downwards and backwards on to the exhibits and the stand generally. The sign also contains tubular lamps which during the day time illuminate the descriptive panels on the front. A two-way switch is fixed at the bottom of each standard for changing over from the main lighting to the tubular lamps, and *vice versa.*

A consistent colour scheme has been adopted for the lighting throughout the stand, and this is carried out in respect of the standard just described by using orange-coloured glass in front of the sign, surmounted by a B.T.-H. monogram in blue.

KELVIN CENTENARY CELEBRATIONS.

To commemorate the centenary of the birth of Kelvin several interesting functions have been arranged by the Kelvin Centenary Committee for July 10 and 11.

At 4.30 on the afternoon of the 10th, at the Institution of Civil Engineers, Gt. George Street, Westminster, the presentation of the Kelvin Medal will be made to Dr. Elihu Thomson (U.S.A.), Sir Charles Morgan, president of the Institution, being in the chair.

This will be followed immediately by the reception of Written Addresses from the Scientific Societies of

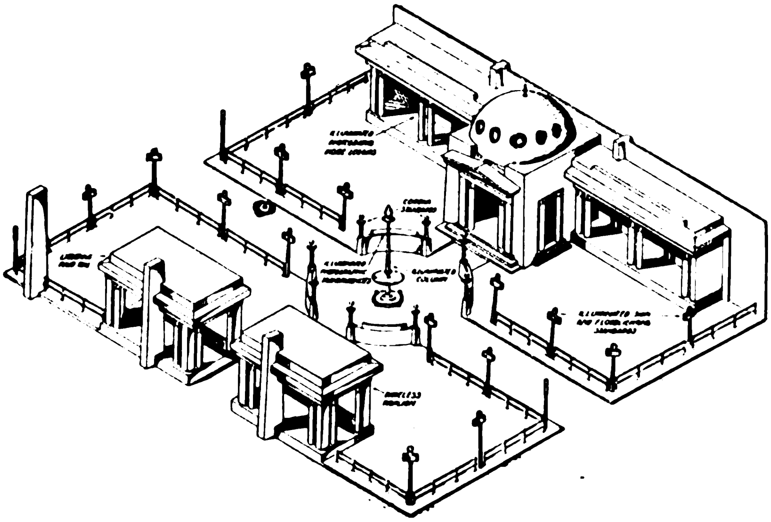


FIG. 1.—ISOMETRIC VIEW OF B.T.-H. STAND AT BRITISH EMPIRE EXHIBITION.

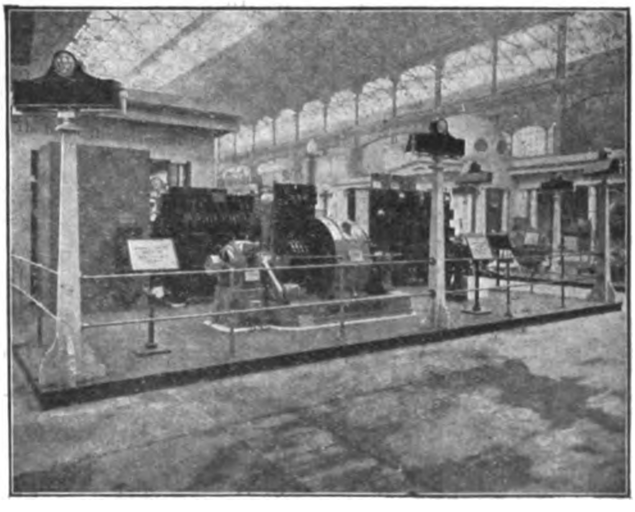


FIG. 2.—GENERAL VIEW SHOWING THE STANDARDS USED FOR LIGHTING THE OPEN PORTION OF B.T.-H. STAND, BRITISH EMPIRE EXHIBITION.

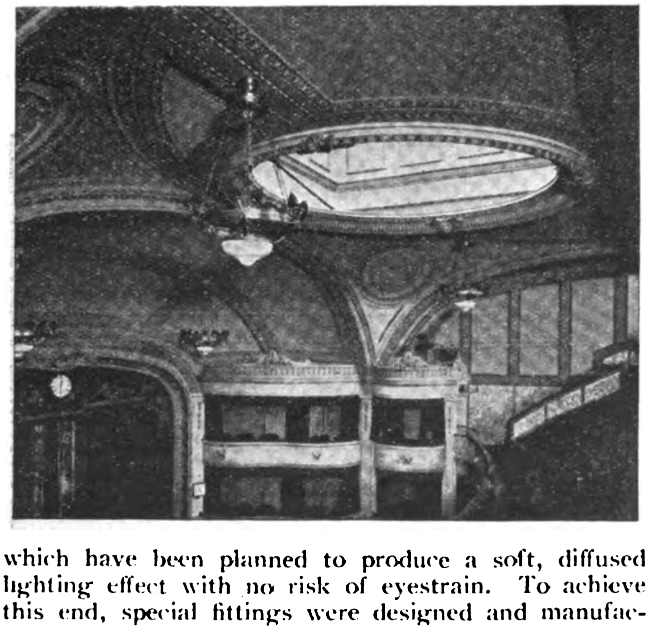
the British Dominions and foreign countries. The Kelvin Oration will then be delivered (about five o'clock) by Sir J. J. Thomson. Sir Richard Glazebrook will preside at the Reception of Addresses and the Kelvin Oration.

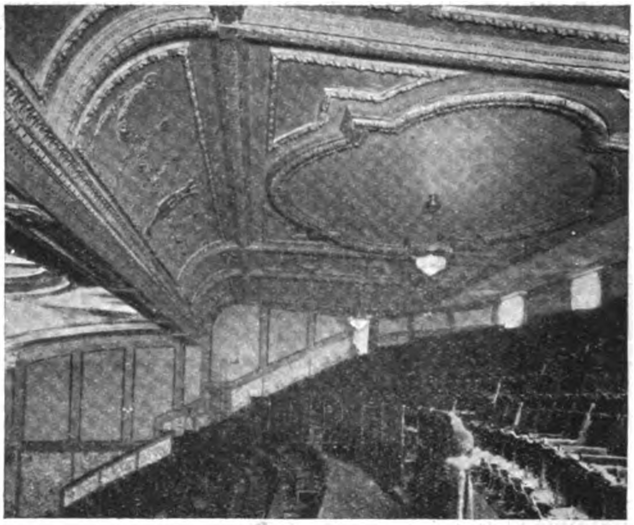
In the same building there will be available for the inspection of visitors an exhibit of Kelvin experimental apparatus which has been collected by the committee specially for this commemoration. These exhibits will be on view from July 8.

An important feature of the celebrations will be a banquet to take place on the evening of Friday, July 11, at the Connaught Rooms, Great Queen Street, London, W.C.2. The Rt. Hon. The Earl of Balfour, K.G., O.M., F.R.S., will preside. Many distinguished scientists and engineers, among them delegates from the societies of Great Britain and the Dominions, as well as the continent of Europe and the United States, have already indicated their intention to be present. Tickets for the dinner, the price of which is £2 2s inclusive of wines and cigars, will be issued in order of priority of application, the seating accommodation being limited. Those who wish to attend the banquet should sent in their application for tickets, with their names and addresses, together with the names of their proposed guests (clearly indicating titles and decorations, if any) to Mr. D. N. Dunlop, Hon. Secretary of the Kelvin Centenary Committee, 61 and 62 Lincoln's Inn Fields, London, W.C.2, to whom crossed cheques for the amount of the tickets should be made payable.

CINEMA LIGHTING.

The Regent Theatre, Norwich, which has recently been opened, is one of the most comfortable cinemas in the provinces, and by the courtesy of Mr. George T. Regment, the consulting engineer, we are able to give some particulars of the electric lighting arrangements which have been planned to produce a soft, diffused lighting effect with no risk of eyestrain. To achieve this end, special fittings were designed and manufactured by the G.E. Co., Ltd. The seven units on the main ceiling over the auditorium are designed so as to harmonise with the decorations. They consist in each case of a substantial ceiling-plate with six stout metal straps supporting a decorative corona band, 4 ft. in diameter, with six pairs of flambeaux brackets carrying ruby-coloured shades. Metal straps springing from the brackets on the main band support a smaller decorated band below, carrying a 24-in. "Superlux" bowl. Each flambeaux shade contains a 60-watt colour-sprayed Osram lamp, and, when illuminated, produces the realistic effects of the old-time "flames," varying in height, colour and intensity; while the main illumination is obtained through the medium of a 1,000-watt Osram gas-filled lamp in the "Superlux" bowl. During the showing of the pictures these units are illuminated, thus meeting the requirements of the authorities by providing sufficient light for entry and exit, yet in no way affecting the picture being shown.





On the balcony and box fronts there are eleven two-light crossed flambeaux gilt-colour brackets with satin shades, and on the back and side walls fourteen two-light brackets of similar design. The first-floor promenade is illuminated by three gilt-colour ceiling fittings with 12-in. "Equiluxo" hemispheres each containing a 100-watt Osram gasfilled lamp, and, in addition, highly decorative effects are produced by handsome flambeaux brackets with long rectangular backplates fixed on the columns.

The large Osram gasfilled lamps in the units over the auditorium are arranged on separate circuits through dimmers worked from the operating-room. These enable any degree of lighting from full-on to all-out to be obtained as desired. A system of master control is also arranged so that, in case of emergency, the auditorium can be instantly flooded with light. What is more, Mr. Regment states that while the lighting is in every respect sufficient in quantity and excellent in quality, the total energy consumption is very much below the average for buildings of this nature.

The whole of the electrical work at this theatre has been carried out by Messrs. Mann, Egerton and Co., Ltd., of Norwich.

Poland.—The report on the conditions of trade in Poland during the last twelve months has been issued by the D.O.T., and may be obtained from H.M. Stationery Office or *Electricity* office, price 1s. 7d. post free. It contains information of much value to all who wish to increase trade with this great country.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of
CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

Wembley and Sunday Opening.

As the advocates of Sunday opening for the British Empire Exhibition are still pursuing their campaign and Mr. George Robey has seemingly joined issue with them, it is opportune to briefly review the *pros* and *cons*. I am no sabbatarian, but at the same time I fail to see the real need for the proposed extension to the usual day of rest. It is urged by the supporters of Sunday opening that, failing this concession, some millions of our population will be unable to visit the Exhibition at all. This somewhat loose assertion implies that those same millions work a 72-hour week. Now I want to know which British trades unions of the present day allow their members to work a 72-hour week, even assuming that industry as a whole were so fully employed as to necessitate such lengthy hours of labour. To my mind the argument is inconsistent.

Unless the railway companies collaborated by running Sunday excursions from the provinces, the whole of the Sunday visitors would be confined to residents in Greater London and its environs, and, if that population cannot find many opportunities of visiting Wembley on Saturday afternoons, or other half-day holidays, to say nothing of every weekday evening, for the full period of six months during which the Exhibition is to remain open, then all I can say is that they don't deserve to come at all. From the trade exhibitors' standpoint there is little to be gained by Sunday opening. On Sundays the Exhibition would only attract the pure sightseer and not the interested type of clientèle. True the restaurants and vendors of tobacco, etc., would doubtless benefit, but what about the additional expendiure incurred for relief staffing of stands and kiosks?

In giving expression to these views I have no desire to curtail anybody's chance of visiting this marvellous collection of our Empire resources, and if any reader can put forward sound arguments in favour of the Sunday opening proposal, the Editor will, I am sure, be prepared to give them equal publicity. All the Press propaganda hitherto has apparently been strongly in favour of the proposal, and no journal appears to have considered the other side of the question as outlined above. If there are *bona fide* workers actually working a 72-hour week for six months continuously, then it seems to me that their labours are worthy of a special concession on the part of their respective employers, and a week off to visit Wembley at a time convenient to both parties should not prove impracticable of arrangement.

Fuse and Cut-out Design.

Personal experience on one or two stands in the Palace of Engineering has brought home to me the fact that there is much room for improvement in the design of some of the smaller and commoner forms of combined switch fuses and distribution boxes. On several occasions I have been called upon to replace a fuse in an emergency, and have had reason to shower anything but blessings upon the designer and manufacturer of the particular fuse box or cut-out involved. In one instance, the fuses are sunk in the cast-iron recessed cover of a combined push-in switch fuse, and are correspondingly inaccessible to the fingers. Furthermore, to prevent splashing, the fuse wire is threaded through an asbestos tube, and to place this tube in position in the spring clips provided is a task calling for considerable dexterity.

In practically all instances the usual rough cheese-headed screws and accompanying loose washers provide the terminal connections, with the result that in nine cases out of ten the fine fuse wire gets fractured or stretched in tightening up the terminals. It is fairly obvious to me that the designers of these primitive devices never have occasion actually to replace a fuse in an emergency, or their design would be speedily amended. It is the old, old story—inaccessibility. Another criticism has to do with the ubiquitous type of D.P. tumbler switch, comprising two single-pole switches with a wooden coupling bar serving as a handle. These wood handles are usually attached by weak and ineffective screws, which break or come loose on the slightest provocation. I manipulated one of these switches before changing a fuse the other day and the screw immediately dropped out, necessitating separate manipulation of the two halves. Accessory manufacturers would be well advised to pay closer attention to some of the minor but none the less important details of design.

The Cheap Unit.

I had an interesting chat with a Canadian visitor the other day anent the "White Coal" which is one of the Dominion's greatest assets. He told me how the Canadian farmers used electricity for practically all their operations, such as cutting food for cattle, pumping, grinding corn, lighting, churning, etc. I complimented him upon his cheap power resources, and added that the absence of the cheap unit in this country was responsible for our backwardness in electrical development. He could not understand why we Britishers did not develop cheap power. "You have fine coal resources," he said, "and your industries are mainly grouped in the immediate neighbourhood of the coal fields. Why don't you build your main power stations at the pit-head? It seems the obvious thing to do." I had to agree with his criticism, and feel very small when I explained how our inborn conservatism prevented us as a nation from doing the obvious thing until overseas visitors succeeded in making us look ridiculous to the world at large.

He also got on to the subject of telephones, and cited the Canadian service as infinitely superior to our own, and cheaper, with the result that practically everybody has a telephone both in house and office. Furthermore, he said, "You are making a great fuss about automatic telephones for London; we've had them in some Canadian cities for years past. How is it that you are so backward?" Again I had to plead tradition, and the superlative difficulty of convincing Government Departments of the merits of anything new or modern. I further explained that the introduction of anything revolutionary of this nature into the Old Country involved the change of a generation bred and trained to the older systems of their forefathers. These views by an observant Colonial should provide food for reflection for certain of our official stick-in-the-muds.

The Underground.

The threatened hold-up of the London underground railways by a strike of the power house staff once more emphasises the need for reducing human attendance on these systems to a minimum. On a vast system such as the tube railways, involving a huge personnel consisting of numerous grades, and with power to combine unofficially and despite the saner counsels of their unions, recurrent labour trouble is inevitable. As usual in such cases the public invariably suffer. One can only assume that these recurrent strikes are the result of monotonous routine duty, and the natural reaction calling for change and an enforced holiday. The remedy would appear to lie in making our railway systems more and more automatic and less dependent upon the human factor. In the present generation we cannot hope to attain to the perfection of a never-stop railway system for London's underground railways with their maze of tunnels, but our railway experts can probably go part of the way towards that ideal by introducing labour-saving devices which would render the system less dependent upon the fickle human factor.

ELEKTRON.

"An Achievement" is the title of a well-printed pamphlet describing the **Macintosh Surface Wiring System**, which should appeal to all electrical installation contractors. It contains excellent reproductions in colour of a dining-room in which, of course, the wiring is quite invisible as well as photograph reproductions of various important buildings in which the system has been installed.

Leaflet L64, which has just been issued by the **Steam Fittings Co., Ltd.**, of West Drayton, Middx., gives illustrations and details of the company's latest Automatic Self-Contained Thermo Electric Quick Break Switches, which have been designed to make and break an electric circuit carrying a very small current.

ABOUT THIS POWER-FACTOR.

By G. E. Moore, A.M.I.E.E.

III.

Last week we reached a point where it was seen that power-factor exists fairly seriously under modern load conditions. But why, if the work gets done, need the fact that the current lags behind the pressure matter? Let us again consider exactly how P.F. affects our power value.

The A.C. power in watts we found to be volts by amps by power-factor. The average power-factor nowadays is about .75, so let us take this value. Now, suppose a certain job requires so many watts of power. If you use a D.C. motor, the volts by amps gives this (we'll neglect motor efficiencies, and so on). Now, let's change over to A.C. Those watts are still required to do the job. If you apply the same volts and amps you won't get the power, because you must remember the .75 power-factor and account for it. So, to get the watts for the job, *more current must be available to make up for the reduction of watts due to the power-factor.*

That vital fact can be stated otherwise. *If there happens to be no power-factor condition, less current need flow.* You can quite rightly regard the D.C. case as being the same as the A.C. one if the latter has unity power-factor.

THE EXTRA AMPS DUE TO P.F.

Now, those extra amps which flow when P.F. is present have to be provided by the supply people, or the consumer would not get his work done. Those extra amps can only be provided by having generating plant of larger capacity than if unity P.F. existed. You will be correct in thinking that this represents loss, but, as a matter of fact, the loss is not so great as it may seem—for technical reasons of too advanced a nature for our present needs. (It is in connection with this that you hear such terms as "wattful" and "wattless," and these concern what are called the useful current and the idle current.)

However, we are not at present concerned with the depths of the subject. The fact that power-factor needs a heavier current flow will be enough to keep in mind. I have already indicated that one result is that heavier plant has to be running at the power station. But there are several other disadvantages—many of which will occur to you. One is that the heavier amperage reduces the generator voltage. Then more or heavier switchgear, cables, and so on are necessary. The transmission lines must carry more amps than if unity P.F. existed, and throughout there are heating and other losses coming in as a result.

All of this, as you will at once see, hits the electric supply authority, while the customer goes scot-free. So long as he gets the power he doesn't grumble, and in most cases only pays for the number of units (or kilowatt-hours) he uses. If he had to pay on the *volt-amperes* it would be a different matter; but what the meters actually respond to are the volt-amperes by the power-factor, which is something much less. Consumers can (and very often do) work at a power-factor of about .5, but that, you see, needn't bother them.

FACTS ABOUT HOW THE SUPPLIER IS AFFECTED.

So it is the supplier of electric power who suffers. And because of the power-factor nuisance, specifications for alternators do not speak ot machines of so many kilowatts, but a certain number of *kilo-volt-amperes* and a power-factor of .75 or .80 is mentioned. With regard to plant capacity as affected by power-factor, some very forceful examples were given by H. E. Yerbury, in the *Journal I.E.E.*, June, 1923.

He stated that to leave unity P.F. conditions and drop to .8 means an *increase* in the kilo-volt-amp (or k.v.a.) capacity of 25 per cent., or *one-quarter as much again* as with unity P.F. On the other hand, supposing .7 P.F. to be existing, and somehow this could be *raised* to .9, there would be 30 per cent. (or, roughly, a third) of the plant *relieved*. This will at once bring home to you how the load P.F. affects the power station.

But the author presented a more compelling example. Imagine two power stations: No. 1 has a capacity of 80,000 kw. and No. 2 of 20,000 kw.; the system fed by these is loaded at .8 P.F. If this P.F. of .8 could be raised to 1.0 ("unity"), No. 2 station could be closed down, or it could be used to supply 15,000 kw. to new consumers. This would add about £1,500 per year to the supply authority's income. Such a station, the author explained, costs about £450,000.

It is not to be wondered at, then, why of recent years power-factor has become one of *the* problems. One special reason is the fact that cables are carrying more current than they would at unity P.F., and that, as the industrial and other needs are growing, more cables must be laid down. But cables are costly, and, if the P.F. condition could be bettered, the old cables could be used more efficiently.

GETTING RID OF POWER-FACTOR.

How can P.F. conditions be bettered? One way is by the use of motors, etc., which run under as good conditions in this respect as possible. It is becoming more necessary to urge that when new plant is to be installed it should run at a good power-factor, and the rated h.p. not too much for the job. But what of plant that is already installed, and of inductive cables, and so forth? Here there are available remedies by the use of auxiliary apparatus.

One kind is the synchronous motor, which runs strictly to speed with regard to the frequency of supply. Such motor, if run with an *over-excited* field, takes a *leading* current from the line, and, if the rest of the load on the line is *lagging*, the over-excited motor tends to wipe this out. As there are many sub-stations which have such motors for converting A.C. to D.C., there is always some relief possible on a system. Again, large condensers can be installed. A condenser, as you will remember, takes a leading (or "fast") current, and so it is just as feasible as with the motor to counter the lagging load current and so raise the power-factor. Often connecting-in a condenser may even give a resultant current slightly *leading*. In addition to synchronous motors and condensers, there are other devices of the so-called "phase-advancing" type like the Kapp vibrator.

Who ought to instal such power-factor correcting apparatus—supplier or consumer? Naturally there will be many cases (for instance with a P.F. load on a long line) where the supply authority, for purely selfish motives, should do so. On the other hand, the consumer, who, after all, is the culprit (though, as a rule, quite innocently), ought to shoulder the burden. But in most cases the consumer, who simply pays for his metered units, knows nothing of power-factor or what it means, and sees no reason why he should be bothered. It is not to be wondered at that he jibs at installing auxiliary plant which doesn't afford him any benefit.

TACKLING THE CONSUMER.

It has been suggested that he should be charged on a kilo-volt-amp basis, and not by kilowatts, so that, if he betters his P.F. conditions, he will reduce his k.v.a., and therefore pay less. Another method is to measure periodically what his power-factor is, or an indicator showing his *minimum* power-factor over a period can be provided. But, somehow or other, the consumer must be made to realise that, by improving his conditions, he is going to *benefit*.

A big difficulty with the average consumer is to explain what power-factor is. Now, in this and the other articles, a semi-technical explanation has been given; a more thorough-going one is possible for those who are prepared to tackle the matter in earnest. But the average consumer knows nothing of electricity—beyond his wireless set, that is—and about this the least said of electrical laws the better! So he must be tackled by giving him some sort of analogy or picture. In concluding this series of articles, I would like to put before you *my*

NON-TECHNICAL EXPLANATION OF POWER-FACTOR.

Electricity may be considered as a servant, the consumer being that servant's employer. If a servant is employed under bad conditions his efficiency is reduced, and he will have to make greater efforts to achieve a result which, under better conditions, he could do more easily. Everybody knows how difficult it is to perform duties when in ill-health—duties which, by comparison, seem light when one "feels in the pink." In industry an employer, by allowing harmful conditions, can be penalised, and the worse these conditions are the heavier the penalty.

Now, in the case of an electrical system, a certain condition known as "power-factor" may exist. This condition can be considered as a form of disease (like anæmia) from which an electrical system can suffer. Although the energy is there, it cannot be fully realised. Part of it is actually mis-spent. For this reason it is necessary to impose a penalty upon the consumer-employer of the current.

How may the consumer avoid this? He can reduce the penalty by installing plant which does not cause the harmful power-factor condition to such an extent; or he can escape it altogether by adopting special auxiliary apparatus which entirely removes the condition. Indeed, in certain cases consumers can so improve their *local* conditions as to cause a *general* improvement, and here supply authorities may still further lighten the charges.

Automobiles are now nearly fool-proof, but their drivers are not.

Leaflets dealing with Bastian Geysers and the Bastian Electric Bakers' Oven have been issued by **Bastian and Allen**, of 58, Haymarket, S.W.1.

TELEGRAPHY.*

Being solutions to the questions set at the Grade I. examination in Telegraphy held by the City and Guilds of London Institute, on April 30, 1924.

Q.—What is meant by the terms magnetising force, reluctance, permeability, coercive force and retentivity? How do the three latter properties in a bar of steel compare with the same properties in a ring of pure soft iron?

A.—Magnetising force is the agency that produces magnetic properties in any substance. Thus, in the case of a bar of very soft iron around which is wound a coil of wire, when an electric current is sent through the wire the bar becomes magnetised temporarily. In this case the magnetising force is the current.

Reluctance is the opposition or resistance offered to the passage of magnetic lines of force through a magnetic circuit. The reluctance of a magnetic circuit is analogous to the resistance of an electric circuit.

Permeability is the ability of any substance to conduct magnetic lines of force. Permeability corresponds roughly to conductivity of the electric circuit, and is defined as the relative magnetic conductivity of the substance under consideration and that of vacuum, the permeability of which is taken as unity.

Coercive force is the amount of negative magnetising force required to reduce the remanent magnetism of any substance to zero.

Retentivity is the ability of any substance to take up or part with magnetism. Retentivity is a measure of coercive force.

The permeability of steel is less than that of soft iron, i.e., soft iron is more permeable to magnetic lines of force than is steel. The coercive force and retentivity of steel are greater than those of soft iron—when the specimens are of the same shape. In the case of a ring of soft iron which has been magnetised (say) by sending a current through a wire wound round the ring, upon the cessation of the current, the ring will retain its magnetism. To demagnetise it, it is necessary to disturb the closed chains of molecules, and this can be done either by sending a reverse current of appropriate strength to the original magnetising current, or by shaking or hammering the ring.

Q.—What are retardation coils, how are they wound, and what material is used? What is their function, and when are they used in telegraph circuits?

A.—Retardation coils are resistance coils used for retarding the growth or discharge of currents in certain systems of telegraphy. The method of winding such a coil is to take the length of wire necessary for the required resistance, and to double it at the middle before winding it on the bobbin. By adopting this method of double winding, the magnetic effect due to the current traversing one half of the winding is neutralised by the effect of the same current flowing in the return half of the winding. Self-induction is thus eliminated.

The wire used is either German silver or platinoid. Retardation coils are used in the compensation circuits of long double current sounder duplex (over 150 miles in length), quadruplex, Wheatstone duplex circuits, etc. A box of retardation coils which is extensively used by the British Post Office consists of 8 coils having a total resistance of 1,100 ohms, the smallest coil having a resistance of 10 ohms.

(To be continued.)

Questions and Answers by Practical Men.

RULES.

***Questions**: We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

***Answers**: A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION No. 182.

In the event of a 20 h.p. d.c. motor failing through no apparent cause, what tests should be carried out to locate the defect? State the tests in their correct order.—A. N. Butler (Wolverhampton).

QUESTION No. 183.

I have an intermittent rating motor starter of 50 h.p., 440 volts, 50 cycles. This starter is contained in a cast iron case which is filled with oil. From tests I have carried out I find that an open circuit exists between two contacts. How can I best remedy this defect? What precautions should I take with regard to the oil, etc.?—"Astatic."

(*Replies to Questions Nos.* 182 *and* 183 *must be received not later than June* 28, 1924.)

THE ENGINEERING REPRESENTATIVE.*

What is a representative?

The answer given to this question will depend largely upon the outlook and experience of the person from whom the answer is required. It may at first appear a simple one to answer, but a moment's reflection will show that this is not entirely true.

If we accept the dictionary as an impartial authority we find a representative described as one who is authorised to act for another or others—he who exhibits a likeness; but a little consideration will show that the foregoing is not adequate when applied to one who represents a firm of lift engineers.

Firstly, the representative is authorised to act for his firm. The card which he presents when making a call is an earnest of this, for it bears his name coupled with that of the firm he is representing, the two being inseparable.

We then come to the record and perhaps more important part of the dictionary definition—he who exhibits a likeness. The reflection of the firm and its policy in the representative is probably the most important factor in his work, for it is largely on the impression created by its representatives that a firm depends for its reputation, and it is its reputation that decides its progress or otherwise. If the representative is a fool or a rogue the reputation of the firm suffers; if he is wise and efficient, this firm will be credited with similar virtues.

---

* Books recommended are:—*Questions and Solutions in Telegraphy and Telephony, Grade I.*, by Few (Rentell, 5s. 10d., post free), and *The Telegraphists' Guide*, by Bell and Wilson (Rentell, 3s. 10d., post free).

* From the *Engineering Gazette*.

It is, unfortunately, a somewhat popular fallacy that a representative or traveller is a person who is entirely devoid of conscience, whereas it is really essential that he should be most conscientious. The conscienceless representative may be able to obtain one order by misrepresentation or otherwise, but instead of making friends, he will create a host of people who are, more or less, thirsting for his blood. Let me state an example.

It is perhaps unfortunate that under our modern civilisation most things are reduced to terms of £ s. d. Now the basic reason for employing representatives is to obtain business, and in order to encourage this it is customary to pay the representative a percentage on the orders he gets.

It often happens that there are a number of alternative solutions to lift problems, each involving a different capital sum, and the customer frequently depends on the specialised knowledge of the representative for advice as to the particular solution he should adopt. The temptation to the representative is to recommend the scheme involving the most money and thus benefit himself at the expense of the client, irrespective of whether this scheme is the one that best fulfils the client's requirement. Looked at from the highest point of view this is morally wrong, and from a lower point of view it is short-sighted policy.

The foregoing, however, by no means covers the many and varied qualities required in one who is going to be a successful representative. To enumerate a few more:—

He should be an expert on his own particular machines, but at the same time should have a wide knowledge of engineering and things in general, that will enable him to advise an inquirer as to the type of machine most likely to suit his requirements, and also the common sense to suggest modifications, etc., to suit the special conditions with which he is constantly confronted.

Further to this, it will be seen that tact is another essential quality. In the course of his wanderings the representative is certain to meet a potential customer who has very definite ideas as to what is required. The representative with his specialised knowledge will realise that some of these ideas are impracticable, and, under these circumstances, it will be his duty, by means of judicious suggestions, to direct the inquirer from his original idea and lead him to one which shall be more practical; but—and this is important—the inquirer must imagine that he has solved the problem of his own accord. It is possible to hurt a sensitive person by unnecessary bluntness, and, in this way, much business is lost.

And, again, the representative should be concise and businesslike, for he will have to deal with many men in big positions, whose time is precious and must not be wasted in listening to many words which have no bearing on the question of lifts, and, after all, this is the most important subject from the representative's point of view.

Finally, the representative should be cheerful, and this is not always easy, for, although this may be possible when he learns that an order has gone to a lower tender, knowing that he will probably get the next order on account of the cheaper machine being unsatisfactory, yet a large portion of his time is spent travelling from one client to another, and the English weather is often a successful antidote to cheerfulness.

In conclusion, let me summarise as follows:—The main reason for the employment of representatives as opposed to other methods of obtaining orders is to bring the firm into personal touch with its clients and thus inspire that confidence and friendship which shall eventually lead to business involving mutual satisfaction.

In order to be successful the representative must embody the spirit of the firm he is representing and must be possessed of that enthusiasm for his firm and their products that can only be obtained by the knowledge that he is representing the best.

Reviews of Books, &c.

[Books noticed in this column will be sent from ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

MAKERS OF SCIENCE. By Ivor B. Hart. Cr. 8vo, cloth, 320 pp., 120 illustrations. (Oxford University Press, 6s. net.)—This is a most interesting book which gives in a sort of chronological sequence brief biographical details of fourteen men, from Aristotle downwards through the ages, who have gained fame through their researches in the by-paths of mathematics, physics and astronomy. The wording throughout is wonderfully chatty and descriptive, and dry commonplace facts and data are presented in a most attractive manner, which makes it a pleasure to the reader. In addition, the text is supported by illustrations which are of material aid in securing his attention without mental fatigue. William Gilbert, who is called the father of magnetic philosophy, has ten pages of interesting text, while the frontispiece of the whole book is a reproduction of the celebrated picture by A. Ackland Hunt, showing Gilbert demonstrating his experiments to Queen Elizabeth, and of which a larger print was issued by our own Institution of Electrical Engineers in the souvenir booklet issued on December 10, 1903, to commemorate the tercentenary of his death. Another chapter deals with the life and discoveries of Andre Marie Ampère, as well as briefly with men like Pieter van Musschenbroek, who discovered the Leyden jar, Franklin, Coulomb, Galvani, Volta and Oersted, followed by later chapters on Georg Simon Ohm, the great Faraday and Lord Kelvin. Altogether the book is so engrossing that once started it is almost impossible to put it down. It should certainly appeal to a very wide circle.

THE JOURNAL OF THE INSTITUTE OF METALS. Vol. XXX. Cloth, 852 pp., with 30 plates and numerous figures in the text. Edited by G. Shaw Scott, M.Sc. (Institute of Metals, 36-38, Victoria Street, S.W.1, 31s. 6d. net.)—This, the thirtieth volume of the *Journal* of the Institute of Metals serves to remind one how quickly the young institute that is responsible for this half-yearly publication has grown up. It seems but yesterday that it was issuing its first volume, a modest compilation of some 300 pages, containing half a dozen papers by British authors. Now comes a tome of over 800 pages, with three times as many papers, and with authors hailing from Russia and France, as well as from this country. The difficult subject of the "Inner Structure of Alloys" is dealt with in a clear and fascinating manner by Dr. W. Rosenhain, F.R.S., in his May lecture, which is now published in full for the first time. Other subjects treated in this issue include the behaviour of metals under comprehensive stresses, hardness, age-hardening of aluminium alloys, electro-chemical character of corrosion, effect of oxygen on copper, effect of nickel on bearing metal, stereotyping, the gold-zinc system, and the properties of phosphor-bronze. These and many other matters of metallurgical moment are discussed by experts whose views often afford most useful supplements to the original papers. The papers and discussions compose half the volume under notice, the remainder being made up of a valuable and comprehensive abstracts section and index. The abstracts, which number many hundreds, and are each above the initials of a well-known expert in some particular branch of metallurgy, are the result of a survey of the the whole world's metallurgical and engineering publications. These abstracts will undoubtedly be invaluable to the busy worker who cannot keep pace with the vast output of technical literature, but who needs to secure a "bird's-eye" view of what is being published, and to know where to turn should he require to consult the original of any particular article. The index, with over 5,000 entries, is a model of its kind. The illustrations, too, are good, and the whole volume constitutes a really useful addition to the technical literature of the day.

Trade Notes.

From **Rayner and Co.**, the well-known patent agents, of 5, Chancery Lane, London, W.C.2, we have received a very neat pamphlet printed in colours and dealing clearly with the necessity for giving due attention to the registration of trade marks as of direct value to all manufacturers in Great Britain who wish to preserve their ideas from piracy both in this country and abroad. We can most certainly commend the pamphlet to the notice of our readers, to whom it will be sent willingly on application.

Pamphlet 500A is a list of Public and Private Automatic Telephone Exchanges that have been manufactured and supplied by **Siemens Brothers and Co., Ltd.**, of Woolwich. More than one hundred exchanges are listed, varying from small private installations of 15 lines to large public equipments such as the Edinburgh network of automatic exchanges, which has an initial capacity of 14,460 lines.——Catalogue 640, Dry Cells and Batteries, is a new edition with revised prices of **Siemens** standard battery catalogue, and full particulars will be found in it of the various dry cells, inert cells, and batteries, and of the recently introduced dry batteries for the high-tension circuit of wireless apparatus using thermionic valves.

Quotations Wanted.—The Electricity Department of the City of Cape Town invite tenders for the supply of 1,000 house-service type A.C. electricity meters.——The Department of Navigation and Ports of the Argentine Ministry of Public Works at Buenos Aires invite tenders for the supply of electrical material, including insulators and insulating material, wires and cables, metallic and carbon filament lamps and holders, telephone bells, mouthpieces and cord, dry cells, etc.——The Public Works Department, Wellington, N.Z., are inviting tenders for the supply and delivery c.i.f. Wellington and alternatively f.o.b. port of shipment of galvanised-iron transmission line hardware. Specifications, etc., from the D.O.T. (Room 52), 35, Old Queen Street, S.W.1.

Various Items.

Wanted.—An electrical installation contractor wishes to receive trade catalogues and lists. See prepaid advertisement.

The Institute of Metals Annual Autumn Meeting.—Preliminary details of the annual autumn meeting of the Institute of Metals show that an excellent programme has been arranged from Monday to Thursday, September 8 to 11 inclusive. The meeting will be held in London, and special railway facilities are being arranged. Only members will be entitled to participate in the special visits associated with this meeting, and in order that intending members may be elected in time for the meeting, a special ballot is being arranged, for which the membership applications should be received not later than July 9. We have repeatedly drawn attention to the benefits to be derived from membership of this institution. Further particulars regarding meetings or membership may be obtained from the Secretary of the Institute of Metals, 36, Victoria Street, S.W.1.

Pulverised Fuel Plant for Birmingham.—The Vickers and International Combustion Engineering, Ltd., of Africa House, Kingsway, London, W.C.2, have received an important order from the Birmingham Electricity Dept. for a complete pulverised fuel installation for the Nechells Power Station, to consist of six Vickers-Spearing boilers, each having a Lopulco type combustion chamber fitted with patent water screen to ensure that the fine ash is deposited in the form of dry dust. Also four bunkers of steel-plate construction with necessary sliding gates to receive the raw fuel and pass it to the dryers; four gravity-type dryers; four patent Raymond roller pulverisers, each complete with fan, cyclone and piping; two compressors and apparatus to convey the fuel from the pulverisers to bunkers above the boilers; six groups of Lopulco feeders, each with four screws and operated by variable speed electric motors; and 24 Lopulco burners, each giving the flat flame which is peculiar to the system. The contract has been accepted by the Vickers Co. on strict efficiency guarantees and for the use of fuel of low calorific value. It will doubtless be watched with interest, as it is the largest order that has as yet been placed in this country for pulverised fuel firing.

GRINDERS
DRILLS
"DEPENDABLE"
& POLISHING LATHES
MARRYAT & PLACE, ENGINEERS.
28 HATTON GARDEN, E.C.2.

(REGD) Vulmos
GENUINE VULCANIZED FIBRE
MOSSES & MITCHELL, LTD. 122 & 124 GOLDEN LANE LONDON, E.C.

Sample Pair Sent on Approval for 8/6
Made of Pure Para Rubber soft and durable and unaffected by climatic conditions
DAVID MOSELEY & SONS.
Limited.
ARDWICK MANCHESTER.
MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL

ELECTRICITY

PRACTICAL TRADE JOURNAL

JUNE 20. 1924.

CONTENTS. PAGE

Installation Work in practice 315
Henley at Wembley 316
Developments in Illuminating Engineering 317
A Novel Frame Aerial 317
Variable Speed A.C. Commutator Motors 318
Current Topics 321
A Well illuminated Florist's Show Window 322
Turning Night into Day 323
The Bastian Electric Baker's Oven 323
Questions and Answers by Practical Men 324
Some Notes on Nomenclature 327
The Fan Season 328
Reviews of Books.. 328

INSTALLATION WORK IN PRACTICE.*

By W. J. Revell.

At the outset, permit me to state that the object of this paper is not to convey or explain matters of a highly technical nature, as this has been dealt with from time to time by more capable minds than mine in the various papers read before this association.

I propose, therefore, to stick closely to the practical side, and if possible deal with the various methods employed by the writer in handling particularly lighting installation contracts, with a leaning perhaps towards large jobs.

I suppose it is no uncommon occurrence for a foreman to be given the plans and specification and with very limited direction told to "get on with it."

My first procedure, before ordering materials other than a certain amount of conduit and conduit fittings, was to carefully survey the whole of the buildings on the site and ascertain as to how far it was possible to standardise each section of each building against itself and building against building, my object in this respect being to ascertain how far it was possible to prepare the conduit, more or less as mass production, before attempting to erect it; and undoubtedly the labour saved in this respect paid handsomely, to say nothing of the better results obtained by uniformity, and the wasteful process of fitting, bending and "offering up" was largely eliminated by this method.

Also in erection it was possible, by putting different men on similar work, to find out which men are paying propositions, and, furthermore, reduced the necessary supervision to a minimum.

After having carefully surveyed the building or buildings it will be found advantageous to set out the whole job on the plan, carefully marking out the runs, and using a different coloured pencil for each size of conduit, in accordance with the number of wires or cables of various sizes to be accommodated.

This is undoubtedly of great assistance to the erector, and also to the foreman, as it enables him to see at a glance if the work is proceeding "according to plan" and the "bugbear" of finding conduits too small to accommodate the requisite number of wires—often at the eleventh hour—is avoided.

In any case, record drawings are usually required at the finish of the work, and these can easily be prepared from the working drawing above referred to.

It is also worth while studying the men working under your charge. Don't be too ready to discharge a man who, although a neat workman, is nevertheless slow on small conduits.

I have frequently had men who were disastrous on cost when employed on small stuff, but who paid handsomely on the larger sizes.

It is also often found that a man may be very expensive on conduit but is a much better proposition on wiring; the procedure therefore is obvious.

The smart foreman who is aiming at efficiency in the work, and also in himself, will find it extremely helpful to keep weekly records of the amount of tubing, yards of cable, number of switches, etc., erected by each man, and by the use of the lay-out plan above referred to this is easily accomplished; but do not make the fatal error of going round each man's job and measuring up his work, as no man likes to think he is too closely supervised, and I have known indiscreet foremen upset their best man by doing this.

Having started the weekly record system, carefully compile a list, based fairly on what you consider the labour per foot of conduit, per yard of wire, etc., should cost, and on this basis price out your labour returns and compare them with your weekly wages bill. I promise you that many of you will get a great surprise.

The advantage of this system is that it can be seen at a glance which men are pulling fairly and which are slackers, and, in the event of the cost going in the wrong direction, something can invariably be done to pull the job out of the fire before it is too late.

A fruitful source of waste is due to the fact that necessary materials are not to hand when wanted.

This sometimes is the foreman's fault in not looking sufficiently far ahead, and sometimes it is the fault of the office in not attending to requisitions. In the latter case it is a good plan to write the office every night urging delivery, and, if necessary, telephone also next morning.

Careful ordering of material is a valuable asset in a foreman, as it is frequently found on the completion of work that a large portion of the profit on a job is tied up in surplus materials, which sometimes is of a special nature and, therefore, not considered good stock, and which with a little foresight might have been obviated.

I am afraid I have dealt chiefly with conduit systems and regret that the prescribed length of this paper will not permit me to touch on other systems of installation work. I think, therefore, that the remainder of this paper can be most usefully devoted to labour hints on cable laying and pole line work, both of which fall within the province of the members of this association. With cable work it is advisable to arrange delivery of cable at such time as the trench is ready to receive it, and it can usually be arranged to jack up the drums whilst these are still on the delivery lorry, and after having anchored one end of the cable, the lorry should, if possible, proceed slowly along parallel to the trench, and two men on the lorry and two more on the ground can usually attend to the paying-out of the cable.

---

* Paper read before the N.A.S.E. and awarded the First Prize and W. E. Highfield Shield, May 19, 1924.

The above process presumes that the cable is being laid on private ground over which it is possible for a lorry to proceed.

Another method of cable laying adopted by the writer was by harnessing a horse to the end of cable after drum was jacked up, and sufficient men distributed along the cable to prevent it being dragged over rough ground.

The first method is, of course, the cheapest way, but the second is much cheaper than employing manual labour entirely, especially as casual labour for this purpose is not always readily obtainable.

With a few remarks on pole line work I shall have, regretfully, to bring this paper to a close.

The pole line route may be over watery ground, where springs abound, or over rocky soil necessitating blasting.

In the case of the former it will be found no easy matter to carry out the excavating, as in these conditions the soil is usually gravel and pumping operations are necessary whilst excavating is in progress.

It is a great mistake to employ a large pump for dealing with the water, as the suction being so great draws away the sand and causes the hole to be continually caving in, until ultimately it bids fair to represent a cavity caused by the explosion of a high explosive shell.

I always found three 2 in. hand-pumps were much better, owing to the lesser suction effect, than a 6 in. steam pump.

Poles planted in water in a gravel soil do not require concrete to set them, as when the gravel is replaced and well rammed, the poles will stand quite firmly, and the writer recently visited poles erected in these conditions twelve years ago, and found them as secure as the day they were planted, although the pole line is in a very exposed position.

In distributing the poles preparatory to erection, it is advisable (presuming that all poles have been marked with their identification by the makers) to take the plan of the route to the station depot and see that the poles are judiciously loaded to facilitate distribution direction from the lorry to the site where each pole is to be erected.

Where this is not practical the poles should be dumped as near as possible to the line route and then a horse hitched to the pole, by means of a chain, will be found useful to drag it to its position.

Excavating in rocky soil is not so difficult as one would imagine, but I would advise those who are not experienced in the use of explosives—should this be necessary—to engage the services of a professional rock-driller from the nearest quarry or mine.

The method employed is as follows:—A hole of suitable depth is drilled downwards in the rocky soil and the explosive cartridge, to which an electric cable is attached, is inserted, and, after being well stamped in, a quantity of tangled wire is deposited on the top of the ground, the purpose of this wire being to act as spring buffers to limit the force of the explosion in an upward direction and also the scattering of the debris.

The effect of the explosion is merely to crack up the ground and render it easy for excavating. Board of Trade regulations, of course, require careful precautions to be taken whilst blasting is in progress.

I regret I am compelled to draw to a close on a most interesting subject and trust that. apart from competitive value, some of the hints contained herein, which have been obtained in actual practice, will be found to be of assistance to the members of this association.

HENLEY AT WEMBLEY.

We expect every reader of ELECTRICITY is well acquainted with the name of Henley, and all that it stands for, in the way of wire, from that which is used for ringing an ordinary house bell to an armoured submarine cable, and at Wembley the Company have made a splendid show, which covers their wide field of manufacture in a remarkably comprehensive manner.

The actual stand, of which we give two illustrations, forms part of the exhibit of the Cable Makers' Association, and occupies a central position in the Palace of Engineering, Avenue 9/10, Bays 15/16. It includes samples of E.H.T. cables up to 66,000 volts, as well as specimens of every kind of cable and wire—power cables; vulcanised bitumen cables; underwater cables for telegraphy, telephony and power; telephone cables up to 1,000 pair and 160 pair multiple twin; rubber wires and cables, and all kinds of wire down to the smallest silk-covered, cotton-covered and enamelled wires. Also, all kinds of jointing materials and tapes are being shown, and the sundry exhibits include cable racks, insulators, bare copper, cable suspenders, etc. The power transmission line has aroused considerable attention, and forms one of the most attractive features on the stand, as it conveys an idea of the work which they carry out in the manufacture and erection of cables for the overhead transmission of power. Other important items are the new improved and patented type of solid rubber cab tyre sheathed trailing cable; the Henley patent vulcaniser; and an installation of the Henley wiring system in a reception room of Jacobean design in panelled oak, which proves their claim that the system is unobtrusive and neat.

The engineering department of the Company is represented by ironclad service cutouts, ironclad switch and fuse boxes, the Henley unit type distribution pillar, joint boxes, colliery cable boxes, industrial lighting boxes, joint box compounds, Q.B. knife switches, and other distribution accessories, the qualities of which are known to practically every central station engineer or installation contractor in Great Britain, as well as to the majority of those in the colonies.

DEVELOPMENTS IN ILLUMINATING ENGINEERING.

The report of the council of the Illuminating Engineering Society, presented at the recent annual meeting, refers to interesting new developments. A feature is the co-operation with other bodies. Thus the British Industrial Safety First Association has issued a revised illustrated edition of its booklet on "Good Lighting as an Aid to Safety." The Society is also participating in the work of the Registration Board in connection with the National Register of Electrical Installation Contractors. The committee on illumination under the Department for Scientific and Industrial Research is now actively at work. The National Illumination Committee has now completely resumed its pre-war activities, and the sphere of its operations has been extended by the formation of a committee under the B.E.S.A., which will concern itself with standardisation in matters connected with illumination.

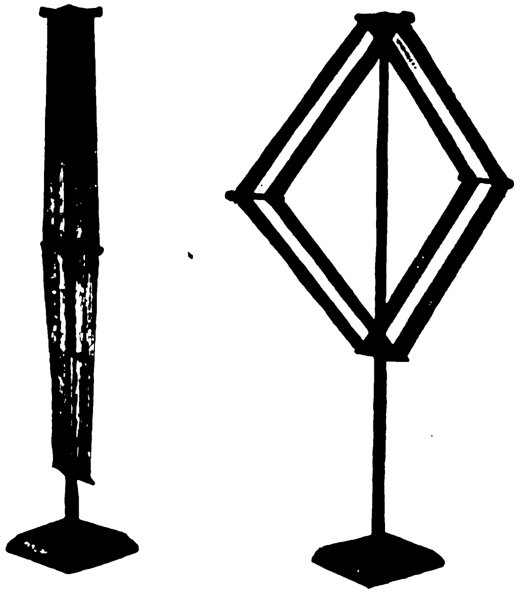
Efforts are now being made to develop propaganda on the benefits of good lighting. The hon. secretary has recently given two talks, which were "broadcast," thus bringing the claims of good lighting before a wide public. A short talk on illuminating engineering was also given by Mr. L. Gaster and Mr. J. S. Dow at the Institution of Electrical Engineers on March 17, and the former is also to read a paper at the World Power Conference. It is also stated that the *Illuminating Engineer*, the official organ of the Society, is to be extended so as to contain more matter of a popular and readable character.

Illuminating engineering is also developing abroad. There were, as usual, many papers read at the annual convention of the American Illuminating Engineering Society, and the societies in Germany and Japan are also doing good work. It is interesting to note that Austria has just recently formed an Illuminating Engineering Society, and no doubt other countries will presently follow this example. At the meeting of the International Illumination Commission in Geneva next month, fuller particulars of progress in various countries should be forthcoming; whilst the first international meeting for the study of industrial hygiene in the same city will afford opportunities for considering industrial lighting from the health standpoint. Readers will recall that a comprehensive report on this subject was recently issued by the International Labour Office of the League of Nations in Geneva. It is evident, therefore, that every opportunity is being taken of making illuminating engineering known both at home and abroad.

A NOVEL FRAME AERIAL.

We have recently had the opportunity of testing the "Chesham Folding Frame Aerial," manufactured by Messrs. W. J. Davis and Company, 2, Queen Anne's Grove, Bush Hill Park, Enfield. We illustrate the aerial herewith, showing it closed and open ready for use. It is an entirely new departure in folding aerials, and it is certainly by far the simplest and easiest to operate.

Unlike any other aerial, it is constructed of rigid wires supported by a polished wood post, which carries insulated brackets to which each wire is hinged; consequently there are no heavy struts to manipulate which would spoil the general artistic appearance of the aerial. The lower bracket or support carries a clamping screw, and when the aerial is not in use the clamping screw is loosened, and the aerial folds on itself—or, in other words, drops to a vertical position as shown in our illustration. In this position it occupies a minimum of space when not in use, or is, when folded, convenient for carrying. When it is desired to use the aerial, the lower bracket is pushed up the post, and the aerial then opens out into rectangular form, as shown in our other illustration.



A very interesting feature is that the aerial can be opened out from the closed position to any desired shape of rectangle, and by sliding the lower bracket up or down the post and so varying the shape of the frame aerial, it is possible to alter the capacity and self-inductance, and so adjust the value to suit the set.

When the right adjustment is found, it then can be clamped by a turn of the clamping screw.

The design is an excellent one, and it is carried out in a thoroughly substantial and workmanlike way. As far as its efficiency is concerned, we were surprised at the results obtained, and we were more than ever convinced that the frame aerial deserves far more attention than it has so far received. The standard model will be found sufficient for ordinary broadcasting wavelengths, but, if any special wiring is desired, quotations will be given on application to the manufacturers.

We are requested to state that, owing to the demand, there may be a slight delay in fulfilling orders. These, however, will be dealt with in rotation, and every effort will be made to give delivery as promptly as possible.

In conclusion, we congratulate the manufacturers on their production.

VARIABLE SPEED A.C. COMMUTATOR MOTORS.*

By H. Dreghorn, B.Sc.

(Continued from page 304.)

Schrage Variable Speed Motor.

Undoubtedly the best variable speed motor yet developed is that due to Schrage, in that it combines the advantages of both these other two without the disadvantages of either. As with the Eichberg motor, and in fact with nearly all A.C. motors, in order to maintain a speed lower than syncronous speed there must be supplied to the rotor phases an E.M.F. of the same frequency and opposite in sense to the E.M.F. induced in them by rotation in the flux, and in order to obtain a speed above synchronism this injected E.M.F. must be reversed.

Suppose now we take a stator winding and connected the various coils to a stationary commutator. If the winding is connected to the supply, then between any of the two brushes there will be a voltage proportional to the angular displacement between them. If these brushes rotate round the stationary commutator with the displacement constant, then the voltage will not be altered, but the frequency of this voltage will vary with the speed. At standstill, the voltage will be at full frequency, and when the speed of the brush rotation is the same as the speed of the electrical field, the frequency will be zero. If the brushes are then connected to the rotor windings, the frequency of the voltage at the brushes will be the same as in the windings. The magnitude of the voltage could be altered by varying the displacement between the brushes, and the phase could be altered by adjusting the axes of the brushes. If the brushes connected to one phase are together, then the motor will run exactly like the ordinary induction motor with its secondary short circuited. Separating the brushes will inject into the secondary phases an E.M.F. of a magnitude depending on the extent of the separation, and will produce a drop in speed so that an E.M.F. will be induced in the secondary winding to equal this injected voltage. Thus, for each angle of separation a different speed will be obtained. When load is applied, further speed drop will take place in order to provide a voltage which will exceed that taken from the commutator by the amount necessary to cause the requisite amount of current to flow to produce the torque. By separating the brushes in the other direction, the phase of the voltage is reversed, and so the E.M.F. induced in the secondary winding must reverse also. This means that the motor speed must rise above synchronism in order that the magnitude of the voltage induced will equal that taken from the commutator. Again, load will be taken by the motor with small drop in speed, but in this case the commutator voltage will be the predominating one.

It is not possible easily to control the separation of the brushes, as they revolve in space, so that in order to make a practical machine, the primary and secondary windings are reversed. Thus the motor has the primary on the rotating element, and the secondary on the stationary one.

It is also necessary to further modify the primary windings, as with ordinary supplies the voltage between segments on the commutator would be much too high. It could be arranged so that only a few of the primary turns are connected to the commutator, and thus have an auto-transformer effect, but except on very small sizes it is found more convenient to have the commutator and primary windings separate and in inductive relation to one another, as the commutator and brush gear is then insulated from the higher voltages of the system. The primary winding is, therefore, placed at the bottom of the slots and connected to slip rings, while the commutator or regulating winding is placed in the same slots above the primary winding, and the ends of the coils connected to the commutator in a similar manner to an ordinary D.C. armature. The brush gear is arranged on two separate yokes, which are coupled together by pinion and racks. The starts of all secondary phases are connected to the brushes on one yoke, while the finishes of the phases are connected to the other. The currents in the primary winding produce the rotating field in a definite direction, and the rotor rotates in the opposite one, so that while full frequency voltages will be induced in the regulating winding, this frequency is changed at the commutator to slip frequency, i.e., the same as is induced in the secondary winding. The voltage between commutator segments is constant at all speeds, and is proportional to the flux, the supply frequency and the number of turns between the segments. The starting condition is thus much more favourable than with the Eichberg motor, as in this case the voltage varied with the speed, being a maximum at standstill. High starting torque can, therefore, be obtained without danger to the commutator. Speed variation will be obtained by turning the pinion of the brush gear, which causes the yokes to travel in opposite directions, giving within limits any desired voltage between the brushes of the same phase.

(To be continued.)

Enterprise.—Readers who are interested in building or in mechanical engineering should make a point of studying the columns of the *Building News* and *English Mechanics* respectively. They are both old-established papers, which do their best to give technical information of thoroughly practical value, and copies of them can be inspected in the files of the Bureau of Technical Journals at Stand 277 in the Palace of Engineering. This bureau should certainly be visited by all our readers when they are in the Exhibition.

*** Paper read recently before the Birmingham and District Electric Club.**

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of
CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application, Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C.2. Telephone No. 2460 Gerrard.

Current Topics.

The Stuff to Give 'Em.

Following on the Communistic debacle, the Underground Railway strike (so-called), I am delighted to note that Lord Ashfield and Mr. Cramp have both proved themselves strong men in the emergency, and have delivered their respective ultimatums to the Bolshevists who are trying to wreck not only modern civilisation, but also Trades Unionism and all the best principles which it embodies. The trouble on the Underground has never been a legitimate disagreement between the employing companies and their employees; it has been engineered by a group of individuals whose business in life is to stir up revolt against established law and order, and it is high time the general public took a hand in ending this perpetual menace to our peace and well-being. At the time of writing the absentees from work have just twenty-four hours in which to return to work or lose their jobs, and it is fairly safe to assume that once the fiat has gone forth and their places have been filled, they will never again serve the Underground Railways of London, greatly to London's advantage.

I regret very much that the E.T.U. (London section), always a highly militant body, should have threatened to throw in its lot with the unofficial trouble-mongers, and I trust that better counsels will prevail. Why should the representative body of the electrical trades always show up to such disadvantage in the eyes of the public? They are invariably in the front rank whenever there is trouble, real or imagined, and their name is rapidly becoming smirched, due to this very ill-considered policy. As for the eight or nine ringleaders of the affair, it is sincerely to be hoped that they do not escape punishment. Having put the whole of London to serious inconvenience and loss throughout the Whitsun holidays, to say nothing of the business community just before and after the vacation, they should suffer in their turn, and it would appear that a term of imprisonment with hard labour as a change from playing on the imaginations of the genuine railway workers would be a mild deterrent against a repetition of this conduct on some future occasion.

Incidentally, I would like to congratulate the entire staff of the Metropolitan Railway upon their sound common sense on this occasion in refusing to join issue with the Communists. They at least have the brains and capacity for analysing facts, and the Wembley crowds should be duly grateful, seeing that this railway is the most important link between the Metropolis and the Exhibition. We want a few more strong men like Lord Ashfield and Mr. Cramp to step into the breach when these crises arise. With a Labour Government in power there is a tendency to play to the gallery with a view to future votes, as evidence the comments of the Labour Minister in the House when the so-called strike was discussed in Parliament. When this unconstitutional action had been denounced by the most influential union concerned, it was surely up to the leaders of the Party to back up their elected officials; they would inevitably have public opinion behind them every time.

As we go to press I learn that the Government is contemplating strong action to combat the Communist menace to both industry and society as at present constituted. In doing this they will justify their election. It is estimated that there are some 5,000 known Communists and extremists in this country; why not deport the whole crowd and end the trouble once and for all, taking drastic steps at the same time to prevent the entry of further members of this abhorred sect?

Non-Co-operation.

Apropos the perpetual breaking-up of roads for the avowed repair and laying of mains of various descriptions, I see that a certain thoroughfare in Harrow which has only been laid twelve months, has been broken up again no fewer than six times within that period for the laying of various mains—water, gas, sewage, electric, etc. This is a flagrant case of lack of co-operation between the various authorities responsible for the roadway and its permanence, and, to my mind, constitutes a case in which strong action might reasonably be taken against the guilty parties. Not only has intense inconvenience been caused alike to residents and the general public, but local traders also suffer from this road-breaking craze, and, if the truth were known, there is probably no earthly reason why the whole of the subterranean work could not have been undertaken before the original surface was laid and consolidated just twelve months ago. Who are the offenders?

Wembley.

Now that the Whitsun holiday is past, stall-holders at the B.E.E. are heaving sighs of relief. Dearly as they love to see the Exhibition well patronised, it is nevertheless a severe strain upon some thousands of humans, both mentally and physically, to entertain and please over 320,000 people all at once. Whit Monday at Wembley was a record in attendances, and, as might have been anticipated, the sieve turnstiles broke down; they were far too narrow to filter in these hundreds of thousands of perspiring humanity in time to enable everyone to spend a reasonable time within the gates

However, all were admitted at some point or other of the many entrances, and for once the weather was kind. The Whit Monday visit was the first glimpse many thousands of people had had of the show, and undoubtedly it will have done its part in inducing as many as can possibly do so to come again and again and see the Exhibition in comparative comfort.

The catering arrangements, although admirable at ordinary times, were unequal to the strain of Bank Holiday, and many who had not foreseen the crisis and brought viands with them had perforce to go away hungry. Messrs. Lyons can do wonders in feeding the crowd, but they cannot perform miracles and feed a third of a million people at or about the same time. In this connection the strain on the restaurants on holidays and other popular occasions is revealing the fallacy of not having provided canteen feeding arrangements for the very numerous staff at the thousands of stands throughout the Exhibition. Of all the claimants to good and regular meals the regular Exhibition staff are undoubtedly in the strongest position. On duty for twelve hours daily, regular meals without the discomfort and inconvenience of queueing up for them every time are a *sine qua non*, and whoever the individual or group of individuals responsible for this serious omission, they have certainly committed a grievous blunder which it is even now not too late to rectify.

The Exhibition and exhibitors' staffs are probably the caterers' most profitable patrons; certainly they are the most regular supporters of the various restaurants dotted about the grounds, and to expect them to queue up at meal times and take their chance with the pleasure-seeking public whom they serve is rather too much of a good thing. Complaints are rife already, and I hope that this menace to the general health and well-being of a hard-working community will speedily be remedied. To be courteous and polite to teeming thousands throughout the day when the sole contents of the stomach are a superannuated ham roll and a cup of luke-warm tea is straining the system to the limit of endurance. What have the B.E.A.M.A., among other interested bodies, got to sav about it?

Lord Kelvin

The centenary of the birth on June 26th, 1824, of our great scientist, Sir William Thomson, afterwards Lord Kelvin, is providing literary material for quite a large number of papers both technical and non-technical, and in the latter category I can include "John O' London's Weekly," which is issuing a Kelvin Centenary Number dated June 21st. In it are two articles of outstanding interest, viz., one entitled "Lord Kelvin," contributed by Sir J. J. Thomson, O.M., who is probably better qualified than any other living scientist to write about the great professor and his scientific achievements, and the other, "Memories of the Master," by J. J. Bell, who writes as one who was a student under Kelvin, and describes the typical routine of the Natural Philosophy Class. I suppose most of my readers know that on Thursday, July 10th, the Kelvin medal is to be presented to Prof. Elihu Thomson at the Institution of Civil Engineers, and on Friday, July 11th, the Earl of Balfour, K.G., will preside at the Centenary Banquet at the Connaught Rooms. In our issue of May 16th, reference was made to the fact that the Masonic bodies bearing the name "Kelvin" are to celebrate the centenary to-night, June 20th, at Mark Masons' Hall, when Mr. Joseph Osborne Pearson will deliver an oration on the subject, and I have every reason to believe that Mr. Andrew Forbes Dick, the worshipful master, who will preside, will find himself well supported by brethren who are associated with one or other of the many branches of the engineering profession which owe so much to the great man whose birthday we commemorate on Thursday next.

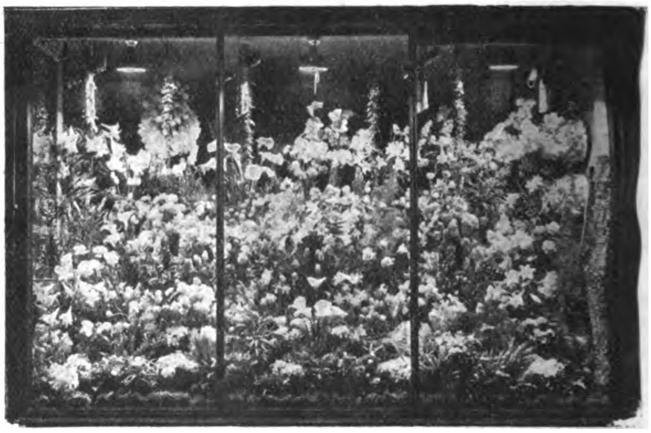
Candid.

In the light of recent and recurrent breakdowns in public electricity supply services, the recent action of the Fulham supply authorities is at least straightforward. Consumers in the Fulham area have been advised of the probable imminence of interruptions in their electricity supply service due to rebuilding at the power station. Cold comfort, especially if the breakdowns are timed to coincide with some of the cold, dark spells to which we are subject as a rule during this English summer. Why building operations should affect the running of existing plant it is difficult to understand; the affected portion of business premises undergoing structural alterations is usually effectively screened off alike from the public and the rest of the establishment and business proceeds as usual. Why cannot this fundamental principle be applied to the Fulham Electricity Supply Works? Maybe the warning is intended by way of an excuse for any unforeseen contingencies in connection with the generation and distribution of electrical energy.

ELEKTRON.

A WELL-ILLUMINATED FLORIST'S SHOW WINDOW.

The success or failure of a show-window lighting installation depends, to a very large extent, upon the wise choice and proper use of lamps and reflectors.



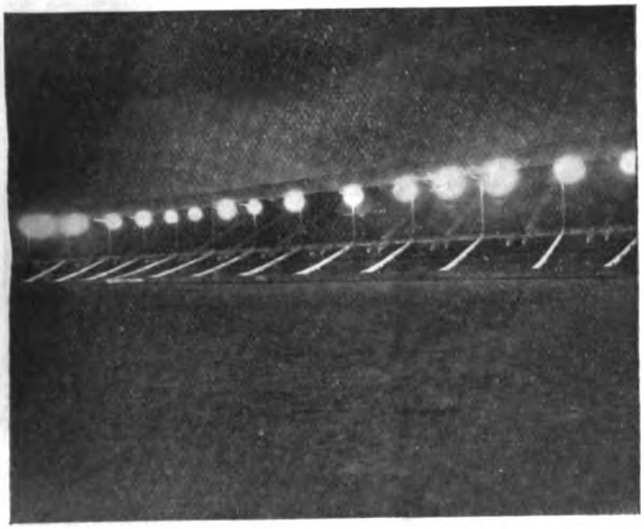
In our issue of March 7, on page 123, we described and illustrated a typical florist's window in the fashionable West End of London, and we now give an illustration of another similar well-lighted window, the property of Mr. Hooper, florist, Carr Street, Ipswich. The even illumination, which is so conspicuous, is produced by means of "Gecoray" reflectors of the "Lustor" type, each of which is equipped with a 100-watt Osram gasfilled lamp, and it is amazing that so much light can be efficiently utilised when one considers that only three such lamps are used. The installation was carried out by Messrs. Wood and Company, Northgate Street, Ipswich.

TURNING NIGHT INTO DAY.

"The light turns night into day."

This remark was heard at London's first, and the world's greatest, Rodeo and Cowboys' Championships, which are being held in the Stadium at Wembley. The cause of the remark was the wonderfully effective floodlighting of the Stadium arena, which makes it possible for contests to be continued after nightfall.

One must witness the contests to realise the necessity for effective artificial light. It would, indeed, be disastrous for cowboys, cowgirls and whirling horses if the illumination of the arena were such that every movement of humans and animals could not be clearly seen.



The transition from daylight to darkness is not observed by spectators of the contests. This is because the floodlights are switched on before daylight commences to wane. In this way the eye "accommodates" itself to the gradual change from natural to artificial light; daylight gradually fades away and leaves the arena brilliantly illuminated. The transition is so unobserved that spectators are surprised, after the show, to find themselves in a world of darkness.

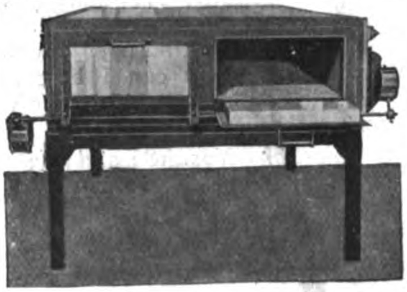
Our illustrations are reproduced from photographs taken in the arena of the Stadium from the light of the forty floodlight projectors used to illuminate the arena at night time. Twenty projectors are fitted on each side of the arena under the covered stands. Each projector contains two 1,000 or 1,500 watt standard gasfilled Osram lamps.

The location of the floodlight projectors has been so determined that from no part of the arena can glare be encountered. The light is very evenly distributed over the whole surface, except at the end where the entry gates are situated. Here a few projectors are situated close together, the object being to provide a higher intensity of light at the point of entry into the arena, thus enabling the cowboys to see "outlaw" horses, etc., more easily.

The installation was carried out by Electrical Installations, Ltd., 27, Martin's Lane, Cannon Street, London, E.C.4.

THE BASTIAN ELECTRIC BAKER'S OVEN.

Our illustration shows a single-section Bastian electric baker's oven, to which one or two additional sections can be fitted, one over the other. Each section has a baking surface of 20 sq. ft., and will



deal with an output of two bushels fourteen times in a day of nine working hours, or, say, 24 sacks per week. Including the initial heating of the oven, the electricity used per sack need not exceed 24 units, and at one penny per unit this is little if any dearer than baking bread with coal at present London prices. As one man and a boy can work the oven, the saving in labour is considerable, and bread baked electrically weighs from 3 per cent. to 5 per cent. more, retaining its moisture and thus keeping "new" longer than bread baked by any other method. Provided bakers will agree not to use the ovens during winter between 4 and 6 p.m., a cheap rate of three-farthings per unit is charged by many electric supply undertakings in London. The Quartzalite heating elements in steel tubes are fixed along the top and bottom of the oven in a way to ensure a perfectly even bake, and six switches permit all necessary temperature regulation to be obtained. With the heavily tiled hearth, "solid" or stored heat is provided to maintain temperature while the oven is being loaded and unloaded.

Germany.—The report on the industrial conditions in Germany which has bene issued by the D.O.T. is a bulky document, and contains a very large amount of information of direct value to the many firms in this country who are interested in exporting to or purchasing from Germany, and we can, therefore, recommend it to their careful consideration. The price is 5s. 3d., post free, from H.M.S.O., or from the office of ELECTRICITY.

Questions and Answers by Practical Men.

RULES.

Questions: ***We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.***

Answers: ***A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.***

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

Question No. 182.

In the event of a 20 h.p. d.c. motor failing through no apparent cause, what tests should be carried out to locate the defect? State the tests in their correct order.—A. N. Butler (Wolverhampton).

Question No. 183.

I have an intermittent rating motor starter of 50 h.p., 440 volts, 50 cycles. This starter is contained in a cast iron case which is filled with oil. From tests I have carried out I find that an open circuit exists between two contacts. How can I best remedy this defect? What precautions should I take with regard to the oil, etc.?—"Astatic."

(Replies to Questions Nos. 182 *and* 183 *must be received not later than June* 28, 1924.)

Answers to Questions.

Question No. 179.

Can any reader give me the technical details of the "Z" connection of instrument transformers used on E.H.T. 3-phase feeder indicator and trip coil circuits? What are the advantages of this type of connection over the ordinary star connection?—"F. B."

Replies to Question No. 179.

The first prize (10s.) has been awarded to "E.M.F." for the following reply:—

The so-called Z connection of the secondaries of current transformers is used mainly in connection with overload protective devices on circuit breakers, and the following remarks serve to show the considerations which have led to its adoption.

Fig. 1 shows diagrammatically the scheme of connections usually adopted for the overload protective devices used on three phase, three wire systems with the neutral point insulated from earth. It will be seen that two transformers and two trip coils, or alternatively a double pole overload relay, are used. It is clear that this affords complete overload protection for such a system, for should a single phase fault develop between 1 and 2 or 2 and 3, at least one trip coil will act, whilst a single phase fault between 1 and 3 would cause both trip coils to function. Further, in the event of a fault to earth developing on one line only, nothing can happen until a fault to earth on one of the other lines occurs, but so soon as such a combinaton of circumstances has become an accomplished fact, we have conditions which are synonymous with a single phase fault between the two lines affected and one of the trip coils must operate.

Now, suppose the neutral point of the system be deliberately connected to earth. The arrangement shown in Fig. 1 would no longer afford complete protection because a fault to earth on one line only amounts to a short circuit between that line and the neutral point, so that even although a fault to earth on lines 1 or 3 would operate a trip coil, a similar fault on line 2 could not operate any protective device with such a diagram. Similar remarks would apply should the system be three phase four wire whether the neutral point be earthed or not, for then a fault between 2 and the neutral line would not operate any coil shown in Fig. 1.

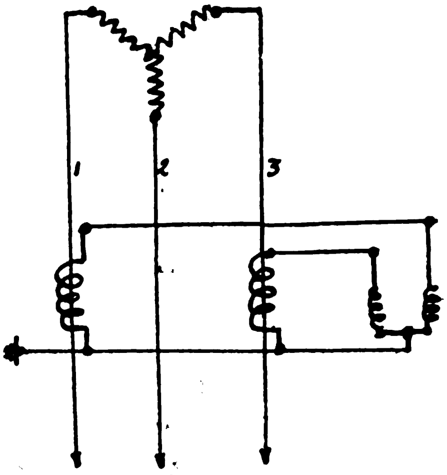


Fig. 1.

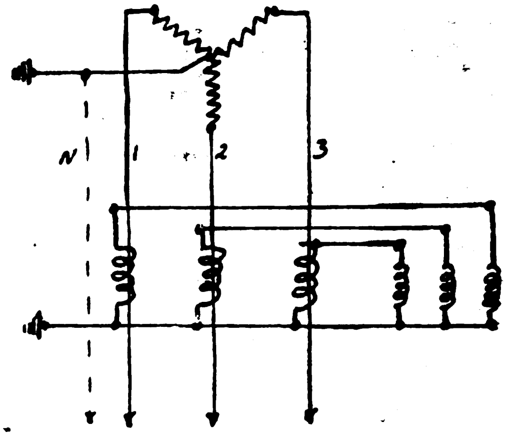


Fig. 2.

Therefore, the next logical step in considering overload protection for three phase systems with an earthed neutral point or for three phase four wire systems is to provide a third current transformer and a third trip coil or three pole relay and connect up as shown in Fig. 2. This affords complete protection.

Now, the addition of the third overload coil naturally adds to the cost of the circuit breaker, whilst it is quite possible that there may, under circumstances where several other trip coils such as no-volt and shunt are required, be insufficient room in an otherwise standard breaker to accommodate this third coil.

To overcome this difficulty the Z system connecting the secondaries was involved. It is shown in Fig. 3, and it will be observed that whilst three transformers are necessary complete protection is afforded with two trip coils only, or alternately a double pole relay.

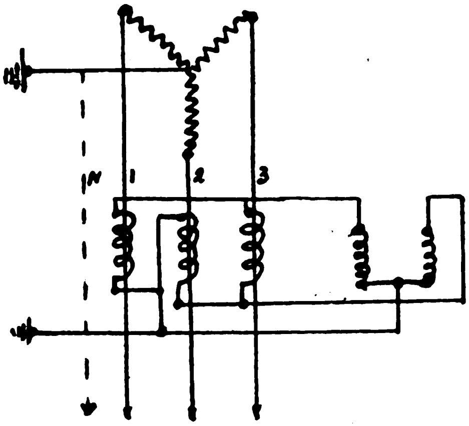


Fig. 3.

Precisely what "F.B." means by the term "indicator circuits" is not quite clear to the writer, but since it is usual to operate such instruments as indicating watt meters and integrating watt meters from the same current transformers as are used to operate overload trip coils, the position may be summed up thus.

The Z method of connecting current transformers possesses the advantage of affording complete overload protection to three phase three wire circuits with the neutral point earthed, or three phase four wire circuits, by means of two trip coils only instead of the three trip coils required with other methods of connection.

Its disadvantage lies in the fact that instruments such as watt meters and watt hour meters for three phase four wire circuits usually require delta connected transformers, and Z connections cannot be used for their operation.—"E.M.F."

The Second Prize Winner's reply will be published in due course.

WORLD POWER CONFERENCE.

The opening reception of the conference will be held on Monday, June 30, at the Conference Halls, British Empire Exhibition. H.R.H. the Prince of Wales has graciously consented to be present, and to welcome delegates from the 35 participating countries. This function will take place in Hall 1, at 3 p.m., and the official banquet will take place in the evening, at the Queen's Hall, Langham Place, W.1, at 7 for 7.30 o'clock, when the president, the Right Hon. the Earl of Derby, K.G., will preside.

Engineers and others interested in enrolling as members and attending the conference should communicate with the Secretary, World Power Conference, 36, Kingsway, London, W.C.2, quoting the names of the technical institutions or societies of which they are members.

Tenders Accepted.—The Army Ordnance Office have accepted the tender of the Edison Swan Electric Co., Ltd., for the supply of 400 Cells Dry X Mark II.——Also, the P.O. Stores Dept. has accepted their tender for 6,000 Fuse Mountings Nk. 4003.

SOME NOTES ON NOMENCLATURE.

In the average engineering factory, the names given to a certain detail are many and varied, and, although when a drawing or a part number is given, the actual name is of little moment, it must be remembered that the number is not always used, many people not being able to break themselves of the habit of calling the detail by name. This name, however, varies considerably, according to the interests of the person concerned.

For example, the drawing gives the name of a certain detail as "washer," and so it is called by all those intimately connected with the system routine. In the shops, however, it is known as a "distance piece" by one group of workers, and a "collar" by another group. Each may be right, especially if there happens to be other "distance pieces" or "collars" associated with different drawings. Then there is the question as to what constitutes a "bolt." Some argue that there is no bolt without a nut, whilst others call the combination "bolt and nut."

There are others who maintain that every hexagon-headed screw is a bolt, and, again, that the detail screwed right up to the head is a screw, a bolt always having a plain shank. Then there is the "set screw" and the "screw bolt," both precisely similar articles, but named in accordance with the function, and the "split washer" and the "spring washer."

Some workers always speak of a pinion as a "cog," and a gear wheel is sometimes called a "bevel gear" or a "crown wheel." A stauffer lubricator is known as a "grease cup," and a taper pin is described as a "conical pin."

No doubt in many cases it is easy to identify the detail by the name given, but the fact remains that often delay is caused and irritation provoked by the requirement not being understood. If a certain detail is wanted, it should not be necessary to search through the records with a view to ascertaining the official name, and yet, if this is not done, it is quite possible for the wrong detail to be supplied. It seems certain that the most obvious and simple name should be used, and steps taken to make its use general.

In some factories a list is compiled giving the names of the various details in alphabetical order, together with the drawing number, so that any one detail can be easily located. This is undoubtedly an excellent idea, but unfortunately, with the variation of names as already commented upon, its object is often defeated. Taking as examples the details already mentioned, if we wish to know the drawing number of a certain washer, we refer to the list under the heading "W." But supposing the man in the shops calls that washer a distance piece? Obviously we look under the heading "D," and mayhap we find "distance piece," Drawing No. 121. The drawing is referred to, but it does not cover the detail required, so the man may suggest that the part is sometimes known as a collar. Once again we go through the list, but, as before, we either get hold of the wrong detail or no item will be found to satisfy us. Then the function of the piece is explained, and, looking under the heading of "W," we find what is required.

As with this, so with the other details. The man asks for a screw, but this is not to be located under "S." It is eventually discovered as a bolt under "B."

So far as these smaller parts are concerned, the difficulty may be overcome by showing similar types of details under a common heading, with the necessary cross references. Thus, bolts and screws would appear under the heading of "B," whilst under "S" would appear the item "Screws—see 'B,' Bolts and Screws." Washers, collars, distance pieces, and packing pieces would all appear under "W," and under "C" would be found "Collars—see 'W,' Washers, etc.," and so on. With more specialised details, however, this cannot be done, and once again the need for complete agreement in the matter of nomenclature is emphasised. Some existing names are, no doubt, somewhat incongruous from the draughtsman's standpoint, but it must be remembered that it is under these names that the details are known to the man in the shops, and he must be very careful when he essays to make a change.

An alphabetical part list, even though the names of the details are fairly well agreed upon, is apt to cause trouble unless the compiling is completely standardised. It should be recognised that the actual name of the detail, and not its qualification, usually determines under what heading the part shall appear. Taking as a first example "Plates," we may get front plates, back plates, bottom plates and spring plates. It is fairly obvious that the whole of these should be found under the heading of "P," and yet the list to which the writer is referring shows the details under "F," "B" and "S" respectively.

To take, as another example, "shafts." These are known as "flywheel shafts" and "driving shafts," and the first-named is listed under "F," while the other appears under "S." Surely both should appear under the heading of "S," otherwise why should "dust cover" appear under "C"? "Oil can" is to be found under "O," but "grease tin" is not under "G," but is to be found under "T." "Inner rail stop" is listed as a stop, and appears under "S"; but after this has been fitted with a pin, although the name remains unchanged, it is now to be found under "I."

The deciding factor seems hard to discover, but surely the common name should have precedence, unless this is prefixed by another name that use has made equally common. Thus all shafts should appear under "S," all brackets under "B," and all plates under "P." Oil can and grease tin would, however, appear under "O" and "G" respectively, for it is evident that, although two words are given, both are necessary to describe the article intelligently.

But whichever idea is favoured, uniformity must be insisted upon. If shafts are to be listed in accordance with the qualification, then no shafts should appear under "S." These part lists are instituted with a view to affording information quickly, but too many are spoiled by the compilation, and until they are standardised they are not worth the time spent upon them.

Trade Development.—Owing to growth of the supplies section of the Metropolitan-Vickers Electrical Co., Ltd., it has been decided to form a separate company to deal with the sale of their electrical supplies. The new company is being registered under the name of the Metro-Vick Supplies, Ltd., and will be entirely owned by the Metropolitan-Vickers Co. The organisation as now existing will be extended, and all inquiries and orders should be sent to the same address as before, the only alteration being in the name of the company.

THE FAN SEASON.

When one receives a well-printed demy 4to catalogue of 48 pp. dealing only with the one subject of electric fans and the working parts thereof, it is safe to assume that the publishers have "some" factory behind them, and as the catalogue referred to comes from the G. E. Company, whose Fan Works at Witton are the largest in the country, it can with equal confidence be relied on to give full details of all that is humanly possible to know about electric fans in general and the "Freezor" fan in particular. Quite so, and with their usual enterprise the G. E. Company have prepared an intensive fan campaign for that hot weather which we hope to get here, and we know one does get in many of the British colonies, where these fans are looked on as real necessities and not mere luxuries. We know how a sweltering July day can be toned down by a current of cool air circulated by an oscillating fan, and it is therefore to be hoped that all retailers and dealers in electrical supplies will avail themselves to the fullest extent of the publicity material which may be obtained from the Company at Magnet House. The catalogue itself is very fully illustrated, and full technical descriptions, with explanatory illustrations of each type of fan, are included, in addition to the usual commercial information, while another valuable feature is a series of sectional drawings showing the position of all spare parts. A price list of these spares, of which a good stock is held, is also given at the end of the catalogue. An attractive price folder, No. V. 1,313, giving particulars of the most popular types of "Freezor" Fans is also available, and dealers can be supplied with quantities overprinted with their names and addresses upon request. Window bills and showcards, 20 in. by 15 in., printed in colours, window circles 15 in. in diameter, are also ready for distribution on a lavish basis, while the novelty parachutes, which formed a feature of last year's campaign, and free supplies of adhesive advertisement stamps for attaching to correspondence, are also offered. If you want more trade, well, get it!

Reviews of Books, &c.

[Books noticed in this column will be sent from ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

RAILWAY DIARY AND OFFICIALS' DIRECTORY, 1924. (McCorquodale-Gibson, 3s. 6d. net.)—This is a very useful work to all who are in any way associated with railway work, and as such has proved its value in the railway world as well as to commercial men generally for very many years. We have no doubt that it will continue to meet with the cordial approval of all users.

GALVANISED STEEL WIRE STRAND FOR SIGNALLING PURPOSES. British Standard Specification. No. 163, 1924.—In this specification are set out the conditions governing the supply of 7/17 S.W.G. Galvanised Steel Wire Strand for Signalling purposes, and it includes a number of definitions and clauses relating to such matters as construction, material, dimensions, lay, and inspection; with regard to galvanising it is laid down that the zinc used shall contain not less than

97.75 per cent. pure zinc. These clauses are followed by particulars of the tests which the wire is required to pass, including the method of taking the test samples, twisting, elongation and tensile tests, also dipping and coiling tests to prove the quality of the galvanising. The specification concludes with directions as to coiling, marking and packing of the accepted materials, and a table giving the percentage elongation, breaking loads, etc., for 17 S.W.G. Wires of various tensile strength.

Copies of this publication (No. 163—1924 are obtainable from the B.E.S.A., Publications Dept., 28, Victoria Street, S.W.1, price 1s. 2d., post free, and also from Electricity Office.

Technical Dictionary: English-Spanish-Portuguese. By T. F. Palmer. 73 pp. (Marlborough, 7s. 6d. net.)—The main object of this dictionary is to facilitate the commercial transactions of British manufacturers and merchants with Spain, Portugal and the great continent of Latin-America. From an approximate count we estimate that there are about 3,500 specially selected English words or terms in this dictionary, and opposite to these, in parallel columns, there are the equivalent Spanish and Portuguese words. The book is divided into eleven sections, corresponding to various branches of industry and engineering, for example, aeroplanes, airships, etc.; automobiles; electricity; machine tools; and so on. In each of these divisions the English words are arranged alphabetically. At first sight it might seem better to have put all the English words in one alphabetical classification, but the present arrangement was chosen deliberately in order to avoid any possibility of confusion arising from the fact that the same English word has different meanings according to the industry in which it is employed. The good judgment displayed by the author in this detail is quite typical of the care which he has exercised throughout the compilation, and we have no hesitation in recommending this dictionary as being exceptionally useful to those who possess a knowledge of either of the languages used, and who are versed in the subjects dealt with.

Correspondence.

ALLEGED PROFITEERING BY ELECTRICAL "RING."

To the Editor of Electricity.

Sir,—In view of the general interest which appears to have been aroused by the discussion at the meeting of the Birmingham City Council on June 3, I send you herewith a copy of my letter to the Town Clerk of Birmingham for publication in your columns.

Yours faithfully,
D. N. Dunlop, Director
British Electrical and Allied
Manufacturers' Association.

June 16, 1924.

[*COPY.*]

Alleged Profiteering by Electrical "Ring."

To the Town Clerk, Corporation of Birmingham.

Sir,—In the Birmingham newspapers of the 4th inst. reports were given under some variant of the above title, of the proceedings of your City Council meeting held on the 3rd inst., wherein Mr. Beale, the chairman of the Electric Supply Committee, in presenting a report as to the prices tendered to a certain contract, is stated to have made certain observations gravely reflecting on this association.

According to the reports, Mr. Beale's statement was to this effect:—

Four contracting firms were invited to tender for some new plant to meet the requirements of a specification submitted to them by the Corporation. The tenders received ranged from £9,000 to £9,765. A certain firm "were making almost identical plant for them at the time. There were some slight differences in detail, but substantially it was the same plant." This firm accidenally got to know of this inquiry and asked to be allowed to submit a tender in accordance with the specification. Their price was £9,360; they were, however, willing to carry out the work as an extra on their existing contract for the price of £3,615.

Upon these "facts" the reports make Mr. Beale comment as follows:—

> Nearly all these big manufacturers were members of an association—the British Electrical and Allied Manufacturers' Association . . . it was obvious that the four firms were either in a ring by themselves or were being controlled by the association.

Mr. Beale then founded on this a homily on the iniquity of profiteering in general, and proceeded to say that it was not the contracting firms he blamed, but the association; it was difficult to see how it could hold together where there was such a "bare-faced attempt at fleecing the public."

To clear the ground I must first point out that neither the governing body of this association nor any member of the staff had any knowledge of the invitation to tender issued by the Corporation, nor of the fact that members of the association were tendering. On inquiry I found that the firms referred to were members of this association, and in the interest of the association and owing to the publicity given to the matter, I invited them to place before me full particulars of the tenders made to the specification issued by the Corporation. I have also had the specification submitted to me.

This investigation, including information from the company which has been successful in securing the order, has revealed that the switchgear called for by the specification was for oil switches and connections to be installed in stone cell-work, each phase to be installed in a separate cell, and the details were such that a considerable amount of development work and of expenditure on special tools and jigs would have been required; in particular the bus-bars and all connections of the switchboards were to be covered with insulating material throughout (including the joints) in such a way that they would withstand a test between the exterior and interior of the insulation of 100,000 volts for five minutes, the working voltage of the board being 33,000. In some particulars, the switchboards were such as have never been manufactured up to the present, and would involve the development of special methods of construction and insulation; even after extended experiment the contract would have involved the manufacturers in considerable financial risk owing to the fact that there existed no previous experience with identical gear. All these considerations naturally prevented the manufacturers from quoting a low price.

The switchgear actually being supplied by the firm already engaged on the first contract is entirely different from that required by the specification, *i.e.*, it

So far as these smaller parts are concerned, the difficulty may be overcome by showing similar types of details under a common heading, with the necessary cross references. Thus, bolts and screws would appear under the heading of "B," whilst under "S" would appear the item "Screws—see 'B,' Bolts and Screws." Washers, collars, distance pieces, and packing pieces would all appear under "W," and under "C" would be found "Collars—see 'W,' Washers, etc.," and so on. With more specialised details, however, this cannot be done, and once again the need for complete agreement in the matter of nomenclature is emphasised. Some existing names are, no doubt, somewhat incongruous from the draughtsman's standpoint, but it must be remembered that it is under these names that the details are known to the man in the shops, and he must be very careful when he essays to make a change.

An alphabetical part list, even though the names of the details are fairly well agreed upon, is apt to cause trouble unless the compiling is completely standardised. It should be recognised that the actual name of the detail, and not its qualification, usually determines under what heading the part shall appear. Taking as a first example "Plates," we may get front plates, back plates, bottom plates and spring plates. It is fairly obvious that the whole of these should be found under the heading of "P," and yet the list to which the writer is referring shows the details under "F," "B" and "S" respectively.

To take, as another example, "shafts." These are known as "flywheel shafts" and "driving shafts," and the first-named is listed under "F," while the other appears under "S." Surely both should appear under the heading of "S," otherwise why should "dust cover" appear under "C"? "Oil can" is to be found under "O," but "grease tin" is not under "G," but is to be found under "T." "Inner rail stop" is listed as a stop, and appears under "S"; but after this has been fitted with a pin, although the name remains unchanged, it is now to be found under "I."

The deciding factor seems hard to discover, but surely the common name should have precedence, unless this is prefixed by another name that use has made equally common. Thus all shafts should appear under "S," all brackets under "B," and all plates under "P." Oil can and grease tin would, however, appear under "O" and "G" respectively, for it is evident that, although two words are given, both are necessary to describe the article intelligently.

But whichever idea is favoured, uniformity must be insisted upon. If shafts are to be listed in accordance with the qualification, then no shafts should appear under "S." These part lists are instituted with a view to affording information quickly, but too many are spoiled by the compilation, and until they are standardised they are not worth the time spent upon them.

Trade Development.—Owing to growth of the supplies section of the Metropolitan-Vickers Electrical Co., Ltd., it has been decided to form a separate company to deal with the sale of their electrical supplies. The new company is being registered under the name of the Metro-Vick Supplies, Ltd., and will be entirely owned by the Metropolitan-Vickers Co. The organisation as now existing will be extended, and all inquiries and orders should be sent to the same address as before, the only alteration being in the name of the company.

THE FAN SEASON.

When one receives a well-printed demy 4to catalogue of 48 pp. dealing only with the one subject of electric fans and the working parts thereof, it is safe to assume that the publishers have "some" factory behind them, and as the catalogue referred to comes from the G. E. Company, whose Fan Works at Witton are the largest in the country, it can with equal confidence be relied on to give full details of all that is humanly possible to know about electric fans in general and the "Freezor" fan in particular. Quite so, and with their usual enterprise the G. E. Company have prepared an intensive fan campaign for that hot weather which we hope to get here, and we know one does get in many of the British colonies, where these fans are looked on as real necessities and not mere luxuries. We know how a sweltering July day can be toned down by a current of cool air circulated by an oscillating fan, and it is therefore to be hoped that all retailers and dealers in electrical supplies will avail themselves to the fullest extent of the publicity material which may be obtained from the Company at Magnet House. The catalogue itself is very fully illustrated, and full technical descriptions, with explanatory illustrations of each type of fan, are included, in addition to the usual commercial information, while another valuable feature is a series of sectional drawings showing the position of *all* spare parts. A price list of these spares, of which a good stock is held, is also given at the end of the catalogue. An attractive price folder, No. V. 1,313, giving particulars of the most popular types of "Freezor" Fans is also available, and dealers can be supplied with quantities overprinted with their names and addresses upon request. Window bills and showcards, 20 in. by 15 in., printed in colours, window circles 15 in. in diameter, are also ready for distribution on a lavish basis, while the novelty parachutes, which formed a feature of last year's campaign, and free supplies of adhesive advertisement stamps for attaching to correspondence, are also offered. If you want more trade, well, get it!

Reviews of Books, &c.

[Books noticed in this column will be sent from **ELECTRICITY** ***Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]***

RAILWAY DIARY AND OFFICIALS' DIRECTORY, 1924. (McCorquodale-Gibson, 3s. 6d. net.)—This is a very useful work to all who are in any way associated with railway work, and as such has proved its value in the railway world as well as to commercial men generally for very many years. We have no doubt that it will continue to meet with the cordial approval of all users.

GALVANISED STEEL WIRE STRAND FOR SIGNALLING PURPOSES. British Standard Specification. No. 163, 1924.—In this specification are set out the conditions governing the supply of 7/17 S.W.G. Galvanised Steel Wire Strand for Signalling purposes, and it includes a number of definitions and clauses relating to such matters as construction, material, dimensions, lay, and inspection; with regard to galvanising it is laid down that the zinc used shall contain not less than

97.75 per cent. pure zinc. These clauses are followed by particulars of the tests which the wire is required to pass, including the method of taking the test samples, twisting, elongation and tensile tests, also dipping and coiling tests to prove the quality of the galvanising. The specification concludes with directions as to coiling, marking and packing of the accepted materials, and a table giving the percentage elongation, breaking loads, etc., for 17 S.W.G. Wires of various tensile strength.

Copies of this publication (No. 163—1924 are obtainable from the B.E.S.A., Publications Dept., 28, Victoria Street, S.W.1, price 1s. 2d., post free, and also from ELECTRICITY Office.

TECHNICAL DICTIONARY: ENGLISH-SPANISH-PORTUGUESE. By T. F. Palmer. 73 pp. (Marlborough, 7s. 6d. net.)—The main object of this dictionary is to facilitate the commercial transactions of British manufacturers and merchants with Spain, Portugal and the great continent of Latin-America. From an approximate count we estimate that there are about 3,500 specially selected English words or terms in this dictionary, and opposite to these, in parallel columns, there are the equivalent Spanish and Portuguese words. The book is divided into eleven sections, corresponding to various branches of industry and engineering, for example, aeroplanes, airships, etc.; automobiles; electricity; machine tools; and so on. In each of these divisions the English words are arranged alphabetically. At first sight it might seem better to have put all the English words in one alphabetical classification, but the present arrangement was chosen deliberately in order to avoid any possibility of confusion arising from the fact that the same English word has different meanings according to the industry in which it is employed. The good judgment displayed by the author in this detail is quite typical of the care which he has exercised throughout the compilation, and we have no hesitation in recommending this dictionary as being exceptionally useful to those who possess a knowledge of either of the languages used, and who are versed in the subjects dealt with.

Correspondence.

ALLEGED PROFITEERING BY ELECTRICAL "RING."

To the Editor of ELECTRICITY.

Sir,—In view of the general interest which appears to have been aroused by the discussion at the meeting of the Birmingham City Council on June 3, I send you herewith a copy of my letter to the Town Clerk of Birmingham for publication in your columns.

Yours faithfully,
D. N. DUNLOP, Director
British Electrical and Allied
Manufacturers' Association.

June 16, 1924.

[*COPY.*]

ALLEGED PROFITEERING BY ELECTRICAL "RING."

To the Town Clerk, Corporation of Birmingham.

Sir,—In the Birmingham newspapers of the 4th inst. reports were given under some variant of the above title, of the proceedings of your City Council meeting held on the 3rd inst., wherein Mr. Beale, the chairman of the Electric Supply Committee, in presenting a report as to the prices tendered to a certain contract, is stated to have made certain observations gravely reflecting on this association.

According to the reports, Mr. Beale's statement was to this effect:—

Four contracting firms were invited to tender for some new plant to meet the requirements of a specification submitted to them by the Corporation. The tenders received ranged from £9,000 to £9,765. A certain firm "were making almost identical plant for them at the time. There were some slight differences in detail, but substantially it was the same plant." This firm accidenally got to know of this inquiry and asked to be allowed to submit a tender in accordance with the specification. Their price was £9,360; they were, however, willing to carry out the work as an extra on their existing contract for the price of £3,615.

Upon these "facts" the reports make Mr. Beale comment as follows:—

> Nearly all these big manufacturers were members of an association—the British Electrical and Allied Manufacturers' Association . . . it was obvious that the four firms were either in a ring by themselves or were being controlled by the association.

Mr. Beale then founded on this a homily on the iniquity of profiteering in general, and proceeded to say that it was not the contracting firms he blamed, but the association; it was difficult to see how it could hold together where there was such a "bare-faced attempt at fleecing the public."

To clear the ground I must first point out that neither the governing body of this association nor any member of the staff had any knowledge of the invitation to tender issued by the Corporation, nor of the fact that members of the association were tendering. On inquiry I found that the firms referred to were members of this association, and in the interest of the association and owing to the publicity given to the matter, I invited them to place before me full particulars of the tenders made to the specification issued by the Corporation. I have also had the specification submitted to me.

This investigation, including information from the company which has been successful in securing the order, has revealed that the switchgear called for by the specification was for oil switches and connections to be installed in stone cell-work, each phase to be installed in a separate cell, and the details were such that a considerable amount of development work and of expenditure on special tools and jigs would have been required; in particular the bus-bars and all connections of the switchboards were to be covered with insulating material throughout (including the joints) in such a way that they would withstand a test between the exterior and interior of the insulation of 100,000 volts for five minutes, the working voltage of the board being 33,000. In some particulars, the switchboards were such as have never been manufactured up to the present, and would involve the development of special methods of construction and insulation; even after extended experiment the contract would have involved the manufacturers in considerable financial risk owing to the fact that there existed no previous experience with identical gear. All these considerations naturally prevented the manufacturers from quoting a low price.

The switchgear actually being supplied by the firm already engaged on the first contract is entirely different from that required by the specification, *i.e.*, it is of their standard metalclad type (not cell type), with direct hand-operated oil switches and without remote electrically-operated control.

The difference in cost of the two designs, one standard and the other experimental, justifies the difference in the prices around which the discussion centred in the City Council meeting.

These are the plain facts of the case, and I have to ask you to acquaint your Council of them and to have equal publicity given to the subject as on the former occasion. In view of the serious charges made against the members of this association, I think you will desire to rectify the false impression created by the statements made at the meeting.

On the general charge of profiteering in the electrical industry, a glance at the balance-sheets of the electrical machinery manufacturing concerns in this country will reveal the fact that there is no foundation for the allegation.

Owing to the publicity given to the statements made at the meeting of he Council, I am sending a copy of this letter to the Press.

Faithfully yours,

D. N. DUNLOP, Director.

Trade Notes.

Publications 2291, 2339, and 2369 have been issued by **Crossley Bros., Ltd.**, the well-known gas engine makers, of Openshaw, Manchester. They describe respectively the Crossley gas engine and suction gas plant; a new type two-stroke crude oil engine; and the company's exhibit at the British Empire Exhibition, and we can recommend them to our readers as of interest to all who are users of gas and oil engine plant, or are likely to be users thereof.

A leaflet is to hand from the **J. W. Buck Switch Co.**, of 39, Victoria St., London, S.W.1. It gives illustrations and details of the Buck Rotary Tumbler Movement Switch, which they claim holds a unique position among high-class tumbler switches. The list should appeal to all installation contractors who wish to use high quality goods.

We have received from the **Machine Tool Trades' Association**, of 70, Victoria Street, London, S.W.1, a copy of a pamphlet which they are distributing at the British Empire Exhibition. It is really a list of the members of the Association and a chart of their products, and is intended to be kept as a reminder of the third Machine Tool and Machinery Exhibition, which is due to be held at Olympia, September 5 to 27, at which the goods referred to in the chart will be exhibited. As such it will prove of interest to all users of machine tools. It is accompanied by a preliminary list of exhibitors and amendments to the regulations in connection with the Exhibition.

Pamphlet No. 451 from **E.D.A.** is entitled "Electricity in Service," and gives clear details with illustrations of the exhibits of the Association in the Palace of Engineering. They deal with electricity in the home and in business, and the pamphlet is certain to be of interest to all who visit Wembley. Also, it is accompanied by a very clear map of the Exhibition, showing the position of the E.D.A. exhibits and the Exhibition buildings generally, so it is certain to be much appreciated.

The April issue of the "Osram Bulletin" has an interesting article on the prospect of a summer boom in Osrams, for which, it maintains, there is an excellent opportunity if contractors and retailers devote attention to the colour sprayed Osram lamp, which can be used so well for outdoor display lighting on promenades, etc. Good examples are given of the night illumination at Hastings, as well as of scientific window lighting, illuminated signs and the effective lighting of the North Circular Road. Altogether, the issue is one which is certain to appeal to a very wide circle of trade readers.

Quite a natty little booklet, entitled "Lights of Home," has been issued by **Messrs. Johnson and Phillips**, with a view to bringing home to the general public the advantages of electricity generally and of the Johnson and Phillips Wiring System in particular. It is well illustrated, the advantages of electricity being set forth in unmistakable terms, and it is to be hoped that it will find its way into the hands of many thousands of householders, to whom it should act as a convincing proof of the ease with which the electric light can be installed when the J. and P. system is adopted.

List No. 1182 has been issued by the **Automatic and Electric Furnaces, Ltd.**, of 175, Farringdon Rd., London, E.C.1. It gives illustrations and particulars of the latest types of hardening furnaces for high-speed steel, and, therefore, should appeal to all users of tools made from this special material.

Impag, Ltd., of 88, Fenchurch Street, London, E.C.3, who are the agents for Micafil, Ltd., of Zurich, have sent us a copy of the latest list of insulating materials which are manufactured by this well-known Swiss company. It is a comprehensive book, and should, therefore, prove of direct interest to all manufacturers of electrical machines and apparatus who require micante, ebonite, fibre or similar goods.

Price list 68, issued by the **Siemens and English Electric Lamp Co., Ltd.**, deals with majolica fittings for ship lighting, and should, therefore, prove of direct interest and value to all installation contractors who specialise in this class of work, as well as to seagoing electrical engineers.——Price list No. 69 from the same company deals with electric fans, and directs attention to the trade opportunities in these goods at the present period of the year.

Various Items.

Wanted.—A reader wants to purchase a copy of Malcolm's "Theory of the Submarine Telegraph and Telephone Cable." For particulars see small advert.

Finance.—The directors of the Launceston and District E.S. Co., Ltd., have just issued their annual report, in which we notice that they propose to pay a dividend of 1s. per share, free of income tax, to the ordinary shareholders for the period August to December, 1923. The outlook continues to be favourable.

Finance.—The annual report of the Westinghouse Electric and Manufacturing Co., of Pittsburg, shows a net income available for dividends of approximately £3,250,000 and orders in hand on March 31st representing about £13,000,000. Evidently business in the electrical industry is very good in the United States.

Sweden.—From the D.O.T. we have received a copy of the report on trade conditions in Sweden. The price is 1s. 7d. net, post free, from H.M. Stationery Office or from ELECTRICITY office, and it contains certain information in regard to the Swedish electrical industry which should be of interest to readers in this country.

Morocco.—The report of trade conditions in Morocco has just been issued by the D.O.T., and may be obtained from H.M. Stationery Office or ELECTRICITY Office, price 2s. 2d. net post free. In addition to a résumé of the opportunities for British trade in that country, there is an interesting account of the very important electrical schemes which are now being put in hand.

Removal.—The Autocar Electrical Equipment Co. announce that owing to increase of business they are removing to larger premises at Mitchell Street, London, E.C.1, to which all communications should be addressed after the 24th inst. In the new premises they will have considerably increased facilities for all electrical repairs, armature re-windings and battery charging.

Annual Sports.—To-morrow, Saturday, the 21st inst., from 2.30 p.m. onwards, the Siemens Sports Club is holding their second annual sports and gala on the club grounds at Park Lane, Charlton, and it is to be hoped that the Clerk of the Weather will treat this gathering in the handsomest possible manner, because a really first-class programme has been arranged, and we shall look forward to giving fuller details in our next week's issue.

Faraday House.—The summer issue of the *Faraday House Journal* has just appeared. The frontispiece is an excellent portrait of Mr. R. N. Vyvyan, M.I.E.E., who is the President of the Faraday House Old Students' Association, and in his commercial life is engineer-in-chief of the Marconi Wireless Telephone Co., Ltd. There is an article describing the City of Winnipeg Hydro Electric System, another on Self-Exciting Alternators and a third on the Internal Combustion Turbine, all of which should be of direct interest to readers of ELECTRICITY. There is also an excellent biography of Mr. Vyvyan, as well as details of the appointments secured by Faradians during the recent months.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

JUNE 27, 1924.

CONTENTS. PAGE

Plans and Reforms for Mains Systems 331
Reaction 332
Electrical Fires 332
Variable Speed A.C. Commutator Motors 333
The Searchlight Tattoo at Aldershot 334
Current Topics 337
Questions and Answers by Practical Men 339
Some Notes on the Electro-Galvanising of Wire 340
Reviews of Books.. 341
Trade Notes 341
Various Items 342

PLANS AND RECORDS FOR MAINS SYSTEMS.

By G. W. Stubbings, B.Sc.

For even the smallest system of buried cables the keeping of a proper and adequate system of plans and records is of paramount importance. In the early days of many of the smaller undertakings this matter did not receive the attention that it deserved, and there was a prevailing tendency to rely upon the memory of the mains foreman, or whoever else was in charge of the actual installation of the cables, for information as to their position. In course of time this source of information failed, with the result that much trouble and cost was incurred in locating the positions of joints and cables concerning which no permanent record had been kept.

The basis of all mains plans is formed by the ordnance maps of the area of supply. The largest scale available should invariably be used. The simplest system is to mark directly on the ordnance sheets the position of all buried cables, ducts, together with all joints and services. Various cables are distinguished by lines of different colours, whilst the nature and contents of duct routes can conveniently be indicated by cross sectional diagrams. Very careful draughtsmanship is necessary if the cables are shown directly on the ordnance sheets, and as new property is erected or new roads made the maps have to be altered accordingly. A somewhat different procedure is to use white prints of tracings from the ordnance sheets for recording the positions of the cables. This method, whilst requiring a considerable amount of work for its inauguration, possesses several advantages. Sheets of smaller size than the ordnance plans can be used, and their replacement when badly worn is easier. In the case of the erection of new property or the construction of new roads, it will be simpler to alter the tracing than the ordnance sheet, since no unnecessary detail will have been shown. It is also fairly easy to enlarge the scale of those districts where the largest scale ordnance sheets are inadequate. Whichever method is in use, the plans or tracing must be kept up to date as regards new property, irrespective of whether or no distributors are in the road. If this be done, the tracings will be very convenient for obtaining prints for schemes for extensions.

It will be impossible to give on the ordnance sheets an adequate record of specially congested spots, such as entries into sub-stations, feeder pillars and so forth. For such parts special plans must be drawn to a scale sufficiently large to give all necessary detail. These plans need not be accurately to scale provided adequate dimensions are given. Special plans should either be drawn in a book kept for the purpose, or on sheets of a uniform size which are filed in a loose-leaf book. If the latter system be adopted the plans can be kept in proper order under a street index. Wherever a detail plan has been drawn a reference should be made at the appropriate position on the ordnance sheets.

Diagrammatic plans of the various systems, H.T., L.T., public lighting, and so on, form an important feature of the records. Such plans show the method of feeding the networks, the position of links in network boxes and the open points in sub-stations. These plans are usually designed for wall mounting, the position of links, fuses and so on being indicated by firm lines drawn by a soft pencil. It is most essential that these diagrams be kept up to date. They should be in the charge of one member of the mains staff, the responsibility of furnishing information as to changes made to the network, of course, resting on the particular member of the staff concerned. Whilst such diagrams are essentially diagrammatic only, they should, when being set out, be drawn as nearly to scale as possible.

Particulars of services are usually kept on the card system, the cards being kept in number order under a street index. If a premises situated in one street is supplied from a distributor in another, a dummy reference card should be inserted in the record to indicate this. Part of the card should be ruled in feint ⅛ in. squares for a hand-sketch showing, with dimensions, the position of the service joint and the run of the cable.

A useful record for three-wire systems is a set of mains balance cards showing the disposition of the load between the positive and negative or inner and middle conductors. On these cards every house or other premises in a road which is cabled, is marked, whether there be a service run in or no. Each house connected to the mains is indicated by marking the approximate load in watts or amperes in one of two columns for positive and negative, or inner and middle, respectively. When such cards are kept it is possible to see at a glance the approximate balance in any particular road, and to decide polarity of new services. The cards are also most useful when it is desired to disconnect rapidly all consumers' installations for testing purposes. It is possible to elaborate the balance cards by indicating on them the size and other particulars of the distributors.

The scope of the system employed depends entirely upon the time that can, with certainty, be devoted to keeping the records up to date. It is useless to attempt too much, for it must be remembered that the times of exceptional pressure outside are the very times when most work has to be put in on the records. Unless, therefore, a mains draughtsman be employed, it will be found that a too ambitious system will sooner or later get neglected and finally break down. Whatever is attempted should be done well, and all work should be entered up the day following, as a rule. Sketches taken on the job should be in strong notebooks, which should not normally contain more pages tnan is required for a couple of months' work, and these books, when full, should be numbered and kept for reference if necessary. Finally, photographs of complicated work taken just before filling in will be found of great service if they can be obtained; these, of course, will be filed with the special sketches.

REACTION.

(*With Special Reference to the Receiving Apparatus Described in* ELECTRICITY.)

In July and August of 1922 we published, at the request of a number of our readers, a general layout of a three-valve broadcast receiving set. At the time this information was given the use of reaction coupled to the aerial circuit—or, in fact, any reaction causing aerial oscillation—was prohibited, and it was for this reason that we omitted information on this subject at that time.

In the issue of August 18, 1922, we published a diagram showing how the reaction terminals were connected in the three-valve set, and we now propose to suggest briefly how reaction may be fitted to very great advantage, as its use will considerably improve selectivity and volume.

One method would be to obtain a short length of ebonite tube about 3 in. outside diameter, arranging this tube to slide into the existing ebonite tube on which the original windings are carried. A number of methods of mounting this slidable tube will suggest themselves to the constructor. The tube may even be supported by the bore of the existing tube, providing means are adopted so that the sliding or reaction tube may be easily moved backwards and forwards, so as to increase or decrease the coupling with the aerial coil. The reaction winding may be of comparatively fine wire, say, 30 S.W.G. cotton or silk-covered, and the turns will probably best be found by experiment; about 30 to 50 turns are suggested as probably being the most suitable. The two ends should be taken to two additional terminals mounted on the ebonite panel, and connected to these terminals by means of two flexible wires. These two terminals are connected to the two terminals marked "R" in Fig. 1, shown in the article of August 18, 1922.

It is necessary to connect to the two "R" terminals the right way round, so, if after connecting up and pushing your reaction coil into your aerial coil the set does not oscillate, the two wires should be crossed over—that is, the one connected to the upper "R" terminal should be connected to the lower, and *vice versa*. You will know if the set oscillates, as you will hear a faint hissing noise, which may be intensified to a violent howl if the reaction coil is too large or too tightly coupled to the aerial coil. The ideal arrangement is for the set to oscillate quietly, when spark signals will produce a harsh sound in the telephones, and the musical notes of C.W. signals will be heard. When receiving telephony the set must be just off the oscillation point.

While we have [illegible] briefly the above method, it is not the one that is really the best for the circuit under consideration. There is no doubt that for the short-wave working, the regenerative circuits used in the United States are by far the best. With these circuits we do not use a reaction coil as described above, but get the true regenerative effect by inserting a variable inductance into the plate circuit of, in the case described, our detector valve. The value of this inductance—and with the set under consideration this is a variometer—must be such that it will tune to the wave-length of the received signal. You will find that the method requires delicate adjustment, and it might be as well here to point out that the average variometer sold for the reception of broadcast transmissions in conjunction with an aerial is not suitable, as it will only tune to the incoming wave-length when added to the inductance value of the aerial. The variometer we have under consideration should have rather more wire upon it, in order to bring its inductance value sufficiently high. The variometer is connected into the circuit by the two "R" terminals previously mentioned.

A suitable variometer covering a range of approximately 180 to 500 metres may be made by making the inner rotating ball about 4 in. in diameter and 3 in. wide, winding this with 27 turns of No. 18 single cotton-covered wire. The outer or fixed tube should be approximately 4½ in. in diameter, wound with about 25 turns of the same size of wire. One of the ends of the rotor winding should be connected to one of the ends of the stator winding, the other two ends being connected to the "R" terminals of the set. When adjusting or tuning, you may find that an adjustment of the plate circuit variometer will necessitate slight readjustment of the aerial circuit variometer, as the one slightly affects the other. Best results are obtained when these two circuits are approximately in tune. The variometer just described may be mounted quite separately and independently of the aerial tuning arrangements, as it is not necessary to couple these together—or, in other words, place them near to each other; in fact, they will probably work better if not placed together.

ELECTRICAL FIRES.*

I have, under the unique City of London Fire Inquests Act, 1888, investigated 173 City fires, as compared with 189 in the year 1922, and 236 in 1921. It is noteworthy that during the year under report, 16 of the fires investigated by me were—with the valuable assistance given me by Mr. Roberts, your Electrical Engineer—proved to be due to defective electrical circuits. One of the most important non-fatal fire inquiries investigated by me during the year 1923 was held on July 20, 1923. The premises burned were at No. 8, Red Cross Street, Ward of Cripplegate Without, City, E.C., and the verdict of the jury was to the effect that "the said fire was discovered at 3.33 a.m., and the London Fire Brigade were called at 3.34 a.m. on the twelfth day of July, 1923; and the fire started on the first-floor landing near the ceiling, and we are unanimously of opinion that the fire was caused by a defective electric installation and close proximity to compo gas tubing, and we suggest that better exits should be made in the reconstruction of the building." Expert evidence—including that of your Electrical Engineer—was given at this inquest, which clearly pointed to the need of legal powers in the City of London whereby a model set of regulations—similar to those of the Institute of Electrical Engineers—might be adopted and carried out by the Corporation of the City of London.

---

* Extract from Dr. Waldo's (H.M. Coroner for the City and Southwark) Twenty-second Annual Report for the year 1923.

The Report of the Royal Commission on Fire Brigades and Fire Prevention—before whom I gave written and oral evidence—published on July 24, 1923, has recently been followed by the printing of the Minutes of Evidence (price £2 2s.).

In my evidence I said I completely agreed with the Departmental Committee of the Home Office on Coroners, who, in their Report of 1910, recommended: "That the benefits of the City of London system of fire inquiry should be extended to the country at large."

Among other matters, I was able in my evidence to contribute as below towards the conclusions and recommendations which were formulated by the Commission, namely:—

"Electrical installations should be periodically inspected and tested in the case of all old buildings, and defective installations should, so far as practicable, be brought up to modern standards," etc., etc.

In conclusion, with a view of prevention and protection from fire, I venture to suggest to your Honourable Court the adoption and circulation to citizens of the 18 practical hints as given by me under Appendix D of the Report.

These directions and hints have been recently adopted, and will be shortly distributed in the form of printed posters.

VARIABLE SPEED A.C. COMMUTATOR MOTORS.*

By H. Dreghorn, B.Sc.

(*Continued on page* 304.)

The maximum movement on either side of the synchronous position will be 90 electrical degrees, one direction giving speeds above synchronism, and the other, speeds below synchronism. If a is the ratio of the number of turns in the regulating winding to the number of turns in the secondary winding, and N is the synchronous speed, then the speed range of the motor at light load will be from $N\ (1-a)$ to $N\ (1+a)$. The value of a must be less than unity, and the speed range possible is limited by the power factor of the machine, especially that of the secondary circuit. The power factor depends on the ratio of resistance to reactance, and for constant current the reactance is low at or near synchronous speed, because of the low frequency becoming greater and greater the further the motor runs from its synchronous speed. With small machines the ratio of resistance to reactance is usually greater than with large machines, and so larger speed ranges are possible with smaller machines. However, it is usually possible to allow frequencies in the secondary circuit of 25 cycles per second, so that with motors operating on 50 cycle systems speed ranges of $(50+25)$ to $(50-25)$, i.e., 3/1 are possible, while with lower supply cycles still greater speed ranges are possible. Motors of 80 h.p. operating on 50-cycle systems with 4/1 speed ranges, and motors of 100 h.p. operating on 25-cycle systems with speed ranges of 4½/1 have been constructed and are running perfectly, and these are by no means the limiting sizes.

It has already been noted that when the brushes of the same phases are opposite one another on the commutator, that the machine operates as an ordinary induction motor with short circuited secondary windings. The primary winding supplies the flux of the machine, which induces in the secondary windings the voltage producing the current in the windings, which, with the flux, develops the torque of the motor. This secondary current is reflected into the primary, and is neutralised by current in the primary, which combines with the magnetising current to form the total primary current.

At certain synchronous speeds it is evident that the current will be in the opposite direction to the regulating winding voltage, and so the regulating winding is taking electrical power out of the secondary circuit. At synchronism it has already been mentioned that the secondary power is supplied by induction from the primary, and at sub-synchronous speeds the part of this which is taken by the regulating winding is handed back to the primary, with the net result that below synchronism only power proportional to the speed is taken from the system. At super-synchronous speed, the regulating voltage is the predominating one in the local circuit, and in this case the current is in the same direction as this voltage. Hence the regulating winding is supplying power to the local circuit, obtaining this from the primary winding by induction, and so again the power input above synchronous speeds is proportional to the speed. The regulating winding, therefore, not only controls the speed but brings about an interchange of energy between the primary and secondary windings, making the input to the motor practically proportional to the output under all conditions, thus producing high efficiency at all speeds. For constant current in the secondary, the torque will be constant since the flux is also constant, and, therefore, the motor-horse-power increases with the speed. The regulating winding and commutator handle only the power above or below the synchronous horse-power, i.e., the slip power, and consequently are small compared with the output of the motor. Thus the commutator can be designed very liberally and, in spite of the low voltage allowable, will be of comparatively small dimensions.

It is possible to improve the power factor of this machine, thus enabling larger speed ranges and better characteristics at low speeds to be obtained than could otherwise be possible. This is accomplished by tilting the phase of the regulating voltage OR by displacing the axis of the brushes. Then a component of the commutator voltage is at right angles to the secondary induced voltage, and so causes wattless currents to flow in the local circuit. If the displacement is arranged to be against the direction of rotation of the machine, then this wattless current will be 90° leading when the motor runs at sub-synchronous speeds, and so cause power-factor improvement. However, at super-synchronous speed, this wattless current is 90° lagging for the same displacement, and so would cause power-factor deterioration. It has already been said that the reactance drop of the secondary winding is one of the causes of the lagging power-factor. This is only so at sub-synchronous speeds, as at super-synchronous speeds this drop in the secondary winding is a leading one and so causes power-factor improvement. Hence, while the power factor at sub-synchronous speeds is naturally low, at super-synchronous speeds it is naturally high, and is usually unity. It, therefore, does not matter much if we give a permanent displacement to the brush gear, and thus obtain better power factor under synchronism with a little deterioration above, but it is better still to make the two sets of brush gear travel at different rates by employing differential gearing. Thus the displacement of the axis can vary with the speed, being a maximum at minimum speed and zero at maximum speed. Normally no improvement would be effected at synchronism when the brushes are opposite each other; but even here it is possible to improve the power factor by gearing which gives only a commutator voltage in phase with the flux of the machine, which means that although no speed regulation occurs, a leading current is produced in the local circuit, which improves the power factor.

---

* Paper read recently before the Birmingham and District Electric Club.

This effect is illustrated by the following test figures taken on a 175-h.p. motor:—

		On neutral..	On lead.
480 R.P.M.	Full load ...	99% leading	97.5% leading.
	Light load...	16% lagging	85% lagging.
240 R.P.M.	Full load ...	65% lagging	83% lagging.
	Light load...	15% lagging	37.5% leading.

(To be continued.)

THE SEARCHLIGHT TATTOO AT ALDERSHOT.

This, which is one of the most popular functions in the social life of Aldershot, is organised during Ascot Week for the benefit of the various military charities in the Aldershot Command. Every year the ingenuity of the Royal Engineers is taxed to the utmost to furnish some new feature which shall make this spectacle more beautiful and more impressive, and this year they surpassed anything previously attempted by introducing special decorative lighting effects, especially in connection with the ever popular musical rides by the Royal Horse Artillery and the Hussars. For the former event the wheels of both guns and limbers and the barrels of the guns themselves were outlined with 4-volt .5-amp. Osram battery lamps, fed from accumulators carried on the limbers, while similar lamps were attached to the bridles of the leaders of each team. Approximately 100 Osram lamps, having a total current consumption of 50 amperes, were used on each gun, and the effect of eight illuminated teams at full gallop in the performance of a complicated ride, performed otherwise in total darkness, was at once striking and inspiring.

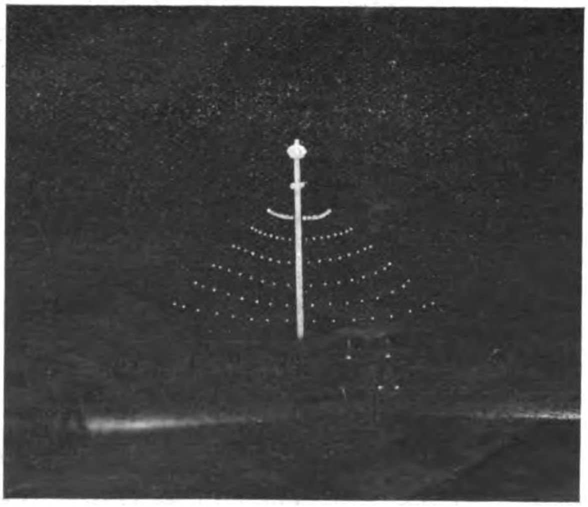


Fig. 1.

More impressive still was the cavalry ride, which this year took the form of plaiting the maypole on horseback. A 36 ft. maypole was used (Fig. 1), the 32 "ribbons" of which were in reality heavy flexible cables fitted at intervals of 4 ft. with 14-volt 7-watt Osram decoration lamps, coloured alternately white and red and enclosed in special wire cages to protect the lamps from breakage. The pole was surmounted by a large Imperial crown (Fig. 2), illuminated in the correct heraldic colours by Osram coloured lamps. Current for this maypole ride was supplied from a special G.E.C. transformer installed in a special underground chamber and taking its supply from the 220-volt military mains, the secondary winding having tappings to give 10, 12 and 14 volts. Additional charm was given to this item when four G.E.C. floodlights, each equipped with one 500-watt Osram gas-filled lamp, were switched on and the dance commenced to a lively air played by the Hussars band.

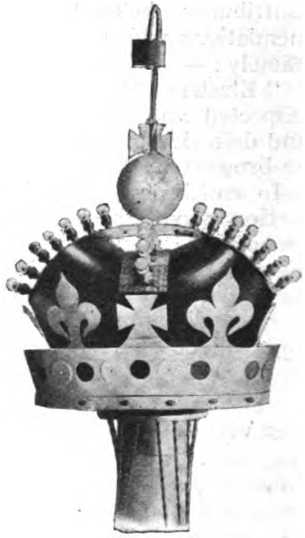


Fig. 2.

A striking effect was introduced at the conclusion of the programme, when, at the end of a roll of drums, the illuminated crown on the maypole was again switched on, and remained, like a crown of living light, poised in the air during the playing of the National Anthem, after which the four floodlights were rapidly moved to selected positions so as to illuminate the whole of the grand stand and enclosures and allow the audience to disperse quickly and without confusion.

Quotations Wanted.—The town electric works at Timisoara, Transylvania, Roumania, are calling for tenders for the supply of a central switchboard.——The Cape Town Electricity Dept. invite tenders for the supply and delivery of high-tension ironclad switchgear. Specifications, etc., from the D.O.T. (Room 52), 35, Old Queen Street, S.W.1.

Dutch Foreign Trade in Electrical Apparatus.—According to official figures published in the monthly book of the Central Bureau of Statistics at The Hague, the imports and exports of electrical apparatus during the first quarter of 1924 have decreased, as compared with the same period of the year 1923. The exports of Electric Incandescent Lamps have fallen off to the extent of 850,000 florins. France, Italy, the Argentine, Australia and Belgium were the largest customers.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of
CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N. 17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application, Subscription : 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

The Aftermath.

Now that the trouble on the London Underground Railways has fizzled out, we must not lose sight of the lesson to be learned. Unless the matter of Communism and its dangers to society is promptly followed up we shall inevitably experience a repetition of the same tactics as soon as the extremists have completed their plans for a fresh outburst in some other quarter. Judging by the questions asked in Parliament, the Government does not appear too keen to conduct the thorough investigation promised at the time of the recent crisis. It must be kept to its task by public opinion, and the subject must not be allowed to degenerate into the proverbial nine days' wonder, to be followed by forgetfulness. The menace of Communism in this country is too serious for such casual treatment, and it is up to our energetic Press to keep the pot boiling until justice is meted out to those responsible for the recent fiascos at Wembley and Lots Road respectively. "Deport the extremists" should remain the popular slogan until every mischief-monger has been hounded out of the British Isles.

Enterprise at Last.

Now that the Post Office has definitely decided on Strowger automatic telephones for Greater London, it is satisfactory to note that the department is also fully alive to the vital importance of training its extensive personnel in the manipulation of the new system. Although automatic in the operating or switching sense, Strowger automatic telephone exchange equipment requires a certain small amount of human maintenance in the way of occasional adjustment, the clearing of faults incidental to heavy service, etc. In this respect it is no different to any other electro-mechanical gear: it will not function indefinitely without attention. The maintenance of automatic telephone exchanges is not, however, a difficult or unduly complex duty, and those telephone maintenance men who have hitherto taken care of the existing manual exchanges should prove equally adaptable to the requirements of the new system.

The success of automatic telephony in this country is entirely dependent upon efficient installation and subsequent maintenance, coupled with a proper instruction of the telephoning public in the correct manipulation of the calling dial. Both these duties devolve upon the Post Office, and in the former connection it is satisfactory to note that a school is being opened for the immediate training of Post Office telephone men in the adjustment and maintenance of the Strowger equipment. So far as the public are concerned, it would appear that clear and concise literature, suitably illustrated and circulated to all subscribers in advance of the installation of automatic 'phones in their houses or offices, should go far towards ensuring efficient use of the dial, whilst the exhibition of an instructional film in one or two of the local cinemas, just prior to the opening of the new exchanges, should also assist in the necessary education of the telephone user and reduce the number of initial complaints that he cannot understand how to use the instrument.

That something of the kind will be needed to get the public familiar with the new system of calling is evident from experience now being gained on the automatic telephone exhibits at the British Empire Exhibition. Considerable interest is beng evinced in these exhibits, and the facilities for practising dialling familiar numbers on the various stands are made full use of. In spite of the working model, which is a feature of the Strowger exhibit, and exactly imitates the motions of dialling a three-figure number, however, it is interesting to note the extremely high percentage of people who, with the model in front of their eyes, deliberately grasp the revolving plate or otherwise manhandle the dial instead of using the finger-tip as indicated. It is to be hoped that the responsible officials in the Post Office section of the Government exhibit are taking due notice of this fact, as a clear indication of the urgent need for popular instruction in this comparatively simple function.

The I.M.E.A.

In his presidential address to the Association at Chester, Mr. S. E. Britton dealt with the familiar backwardness of electricity supply in this country and its causes. He backwardness of electricity supply "penny packet" system of small local authorities and limited areas of supply, coupled with the many vested interests, local jealousies, diversity of systems, etc. It is opportune for these crying evils of our present electricity supply services to be publicly voiced before an influential body like the I.M.E.A. It is one of the most urgent needs of this country that we require a broader view of electricity supply and concentration on a universally cheaper unit. We might with advantage follow the example of Canada, where the original power companies operating from Niagara Falls, failing to bring down their tariff to a commercial basis, were compulsorily acquired by the Dominion and a low fixed rate amounting to ab [illegible] annum per E.H.P. instituted. As a result every farmer in Canada to-day has cheap electrical energy, and, very naturally, makes use of it for every conceivable purpose. Our greatest need in this country at the present time is a similarly cheap unit; the rest would inevitably follow and the splendid efforts of the E.D.A. reap their due reward.

A Trade Revival?

Whether as a direct result of the British Empire Exhibition or other contributory causes, signs are not wanting of a much-needed revival in the prospects of industry in this country. There have recently been gratifying reports of several large contracts coming to British manufacturing firms, especially in the electrical engineering and allied trades, whilst a survey of the Divisional Reports in the current monthly journal of the Amalgamated Engineering Union reveals a healthy unanimity of opinion that things are looking much brighter and that unemployment is slowly but surely decreasing in every industrial district. This is all to the good, and, if conditions continue to improve throughout the year, next winter should find our industrial population in a much more satisfactory condition than was the case in 1923. If only we could eliminate the pernicious dole system and its harmful effects upon the morale of the wage-earner we should indeed have achieved an industrial millennium.

Wonderful Wembley.

The British Empire Exhibition still continues to attract huge crowds daily. No matter the number, there is ample room for all comers in the extensive grounds and many interesting pavilions. The Stadium events also constitute an attraction, and, having witnessed the much-discussed Rodeo, I can affirm that it is not so bad as it has been painted by some folks. Certainly there is an element of risk, alike to men and animals, but what form of sport or entertainment in these delirious times would attract the public if all danger were eliminated? The next great event is to be the Pageant of Empire, to be held from July 21 to August 30, a splendid function depicting the history and progress of the British Empire from the earliest recorded times. Every patriotic Briton or Colonial visitor who can possibly manage to visit Wembley during the period of the pageant should make a point of witnessing it; according to report, there has never been any prior display so calculated to inspire pride of race and birthright.

More About Cheap "Juice" Patrons.

I have written before in these columns about the clever gentry who like to obtain their current on particularly favourable terms to themselves, generally by interfering with the meter circuit. But here is a case in which a somewhat unusual method was adopted, the offender this time being a large power consumer and a person of some importance in the neighbourhood. He had his house wired by a local electrician, the installation being connected to the supply at his works near by. As is the general rule, local electric supply is charged at both "power" and "lighting" rates—the former, of course, being less than the latter. The enterprising gentleman was therefore patronising the *cheaper market*. However, the Electricity Committee didn't like his business methods at all, and their customer was summoned for having "fraudulently abstracted certain electricity." In spite of an eloquent address on behalf of the defendant, a heavy fine was imposed.

A number of years ago I heard of a novel indirect case of the poaching of electricity. H.T. alternating-current power was transmitted through overhead wires at the bottom of the culprit's garden; he must have known something of electrical induction, for he slung an aerial almost perilously near to a power line, and, it was said, managed to get some lighting gratis. Then, too, there is the story of the inventor who, on the eve of his great discovery, had his supply cut off and the meter removed. Of course, this disaster was brought about because, like most inventors, he lacked "the ready." You can guess what he did! And how justified he felt when the invention turned out to be a success! Yet, you know, I feel there must be some moral kink in the make-up of these adaptive people. Just consider *this* case—very different. A shopkeeper on the supply system with which I was connected was "on his beam-ends" financially, and, after several fruitless warnings from the company anent his unpaid bill, a man was despatched to cut off the supply. Faced with the serious loss of his shop lighting, the consumer was forced to save the situation by paying the bill from the till—*the whole of his cash resources in the world.* Why didn't *he* try trickery? "Ah," says the cynic, "because he didn't know *how*." Well, thank goodness, the world of people isn't as bad as the cynic implies.

Lessons from the Recent Storm.

The first lesson was in the nature of a demonstration. Owing to the heavy rain and probably the presence of old colliery workings underground, a serious subsidence in a country road took place—many yards across and several feet deep. As luck would have it, this was the spot where an armoured cable, laid direct into the ground, crossed the road. There the cable was, left in mid-air but unaffected, and supply not broken! The next lesson was a little later, when an overhead 3,000-volt line was inspected. This had been struck by lightning and had practically "cleared" itself, the same flash having somehow also split the roof of a house. However, some potential transformer fuses had blown, and I heard a "tip" which I'd never met with before. To test the transformer it was suggested that a cat should be allowed to walk on top among the terminals! *Be allowed*, mark you!

Respect for H.T.

Many people think that cats are stupid, mistaking the cat's natural dignity for "denseness." I've never agreed, especially when remembering the number of cats which have made themselves at home in boiler houses, turbo rooms and switch chambers. For "stupid" animals they seem to be remarkably able to take care of themselves in dangerous surroundings. So far as I've seen they've managed to keep their distance from both live steam and live connections. And, with regard to the latter, I think they've got some sort of electrical sense which they find useful. (After all, isn't the catskin the standby of those electrostatic experiments we had at school?) Anyway, like humans, cats have a respect for high-tension "juice," and, I suspect, a little more gumption. But I don't think they are so nervy about it. Electrical men, especially after they have had one or two "bites," become very chary.

The other day I was installing some testing gear underneath a 6,000-volt 10,000-kw. generator. The machine was "dead," and earthed. Before the electrician (an experienced man) had actually made a connection on to the stator terminals, he jumped back in alarm and swore he had had a shock. So far as I could see the only cause was a sharp end of wire—there were certainly "no volts to earth." It was only after much persuasion that we got the job going again! And I recall a certain sub-station receiving A.C. supply at high pressure where periodically the handyman had to clean certain gear in cubicles. Each cubicle, of course, was made dead and formerly live parts earthed, but the dubious fellow wouldn't start his cleaning until the switchboard attendant had actually touched all the parts with his own hand! The handyman thought that there's nothing like making sure. The switchboard attendant's opinion of the handyman had better not be printed in "Current Topics."

ELEKTRON.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: We invite our readers to send us questions, preferably on technica' problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.

ANSWERS: A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 182.

In the event of a 20 h.p. d.c. motor failing through no apparent cause, what tests should be carried out to locate the defect? State the tests in their correct order.—A. N. BUTLER (Wolverhampton).

QUESTION NO. 183.

I have an intermittent rating motor starter of 50 h.p., 440 volts, 50 cycles. This starter is contained in a cast iron case which is filled with oil. From tests I have carried out I find that an open circuit exists between two contacts. How can I best remedy this defect? What precautions should I take with regard to the oil, etc.?—"ASTATIC."

(*Replies to Questions Nos.* 182 *and* 183 *must be received not later than June* 28, 1924.)

Answers to Questions.

QUESTION NO. 179.

The second prize (5s.) has been awarded to T. J. Barfield, Ommaney Road, New Cross, London, S.E.14, for the following reply:—

The "Z" connection is a method of connecting trip coils or relays operated from the secondaries of current transformers, so that on a three-phase system with earthed neutral two trip coils may be operated from the secondaries of three current transformers to give three-phase protection.

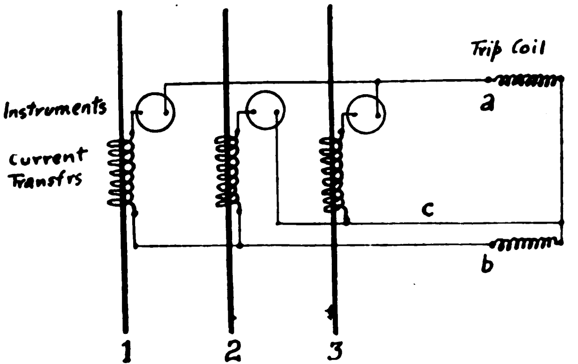


FIG. 1.—DIAGRAM OF CONNECTIONS.

From the diagram of connections it will be seen that the current in trip coil *a* is the vectorial sum of the currents in the secondaries of current transformers 1 and 3; thus, with 5 amps. secondary current in 1 and 3, 5 amps. will flow in *a*. Similarly, the current in *b* is the vector sum of the currents in the secondaries of 1 and 2.

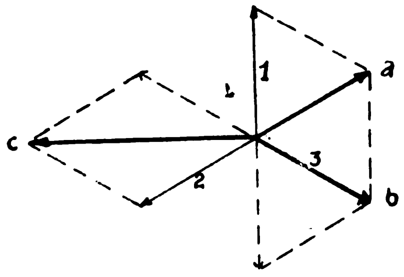


FIG. 2.—VECTOR DIAGRAM OF SECONDARY CURRENTS.

Theoretically, this method of connections gives complete protection, but actually the protection afforded is rather uncertain. From the vector diagram it will be seen that if an overload occurs in one phase only, and the current in this phase lags relatively to the other phases, the overload required to operate the trip coil may either be greater or less than the theoretical setting. For example, if the trip coils are set to operate at 100 per cent. overload, then with full load in phase 3 an overload of 200 per cent. in phase 1 will be necessary to operate the trip, if the current in this phase lags by about 60 degrees. Similarly, if phase 3 is overloaded and the current lags, very little overload in this phase will operate the trip coils.

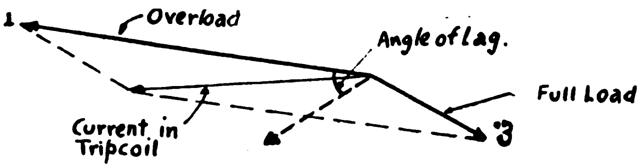


FIG. 3.—VECTOR DIAGRAM—ONE PHASE OVERLOADED AND LAGGING.

"Z" connections cannot be recommended for circuits of any importance where accurate settings are required, and on less important circuits it is more satisfactory to employ three current transformer operated trip coils in place of two expensive relays connected in "Z."

If instruments are connected in circuit it must be remembered that the current in *c* is 1.73 times the current in *a* or *b*, balanced load being assumed.

Various similar connections have been used, such as the "Reversed V" connection for operating one trip coil from two current transformers, for a full description of which the reader is referred to C. C. Garrard's "Electric Switch and Controlling Gear."—T. J. **BARFIELD**, 57, Ommaney Road, New Cross, London, S.E.14.

SOME NOTES ON THE ELECTRO-GALVANISING OF WIRE.

By SHERARD COWPER-COLES.

The coating of steel wire with zinc by passing it through molten zinc is the process at present universally used, not because it gives satisfactory results but because it is the only process that so far has proved commercial. The zinc coating obtained by the molten process is uneven and lacks adhesion.

It is not generally known that there are several classes of galvanised wire on the market, which has done much to bring galvanised wire into disrepute. One class of galvanised wire is known in the trade as wiped wire, being passed through an abestos wiper as it leaves the bath, removing most of the zinc, and often removing it entirely in places due to the zinc binding in the wiper. The better class of wire has much more zinc on it, as no wiper is employed, but it is generally passed through a bed of sand placed on the top of the molten zinc for the purpose of removing excess zinc and making the coating more even.

Another disadvantage of hot-galvanising is that the temperature of the molten bath is sufficiently high to affect the temper of some classes of iron, and it also forms on the surface a zinc iron alloy which is a source of weakness when very fine wire is subjected to the process. The impurity of zinc is also a serious disadvantage, containing lead and iron often up to six per cent., making it brittle and less resistant to corrosion.

Many attempts have been made to electro-galvanise wire, but so far they have not proved commercially successful so as to compete with hot galvanising, the chief difficulties encountered being dullness of deposit and weak or bare places in the zinc deposit.

The following in chronological order are some of the most important patents relating to electro-zincing of wire, being types of different classes of apparatus.

One of the first patents for coating wire with zinc by electrolysis was that of Fox (No. 3455/1879) as shown in Fig. 1, which is sufficiently clear to need no description. The apparatus shown is typical of a great number that have been tried from time to time, which have all been abandoned as the apparatus does not embody the necessary factors for commercial success, being too slow, the floor space required for a large output being prohibitive.

Fig. 2 shows another type of apparatus for electo-zincing a whole coil of wire at a time, patented by Wallace (No. 3315/1882). One great difficulty of such a process would be ensuring all the wire being an equal distance from the anode, necessary for an even coating of zinc. The intermittent exposure of the zinc deposited on the wire would also be a serious drawback, as it tends to laminations.

Another class of apparatus is shown in Fig. 3—Hemming's (Patent No. 5508/1891)—a coil of wire being unwound from one spool to another in the solution. The chief drawback to such an arrangement is that the wire would have varying thicknesses of zinc, and the zinc would not be uniformly adhesive, as some portion of the wire would be in the zincing solution a considerable time before being coated with zinc.

(To be continued.)

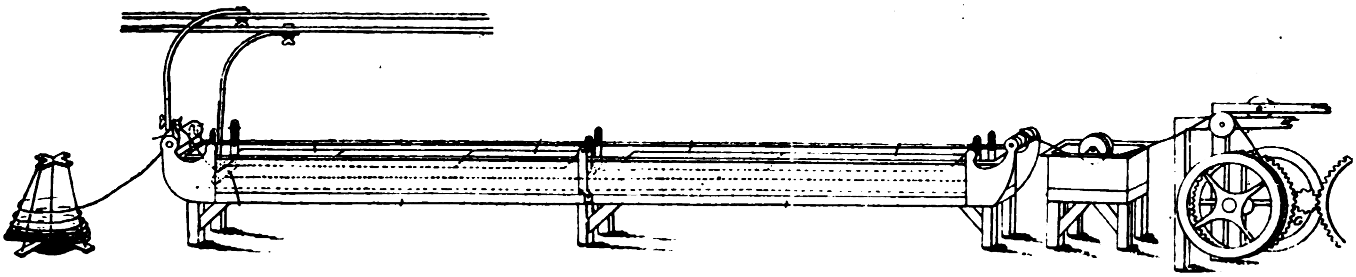


FIG. 1.—FOX'S APPARATUS.

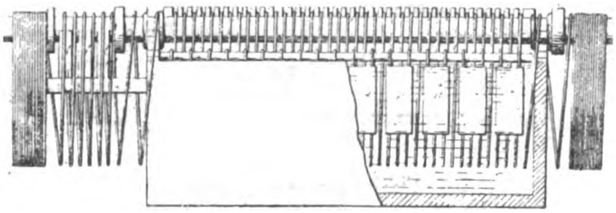


FIG 2.—WALLACE'S APPARATUS.

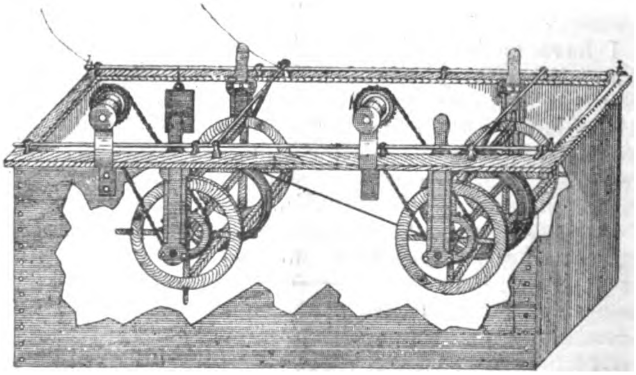


FIG. 3.—HEMMING'S APPARATUS.

Reviews of Books, &c.

[*Books noticed in this column will be sent from* ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.*]

MODEL RAILWAYS. By Henry Greenly. Cloth 8vo, 311 pp., over 400 illustrations. (Cassell, 6s. net.)—We have already had the pleasure of reviewing Mr. Greenly's books on model locomotives, and we can now extend a most cordial welcome to this new work on model railways, which deals very fully with their design, details and practical construction. Mr. Greenly has had more intimate experience of model railways than anybody in England. To his unequalled knowledge he brings to bear a clear and informative style of writing and great expertness in the production of illuminating illustrations. The book lays down the principles and explains fully all details of construction. It is of absorbing interest to the hobbyist, and invaluable as a work of reference, dealing as it does with all phases of model railway work both electrical and mechanical, while the chapters on power signalling are likely to be of direct technical value and should interest electrical engineers generally.

MARSHALL'S PRACTICAL WORKSHOP SERIES. (9d. each net.)—We are in receipt of Nos. 1, 2 and 3 of this new series of small handbooks, published by Percival Marshall and Co., 66, Farringdon Street, London, E.C.4. Their titles are "Marking-Out for Machinists," "Practical Hand Forging," and "Fitting and Adjusting Smiall Bearings." All three books have been written by Capt. Richard Twelvetrees, A.M.I.Mech.E. It would be necessary to devote a whole column to an adequate description of the usefulness of these small handbooks. As their titles suggest, they are written from a practical point of view, and they contain very many "tricks of the trade" which we feel sure will be of interest to experienced journeymen. "Marking-Out for Machinists" is exceptionally valuable from the fact that a section of the work deals with "how errors multiply." It is well written, and deals very fully with the cause and effect of badly marked work. At the small price of ninepence they are within the reach of all apprentices and students in technical schools.

TECHNICAL LEXICON: ENGLISH-FRENCH. By G. A. E. Jacquemard. 178 pp. (Paris, G. and M. Ravisse, 12 fr. 50 c.)—It is unfortunately almost impossible to review a dictionary, for the merits and demerits of such a work can only be discovered by the practical use of the work over a considerable period of time. We can say, however, that we have tested the work now before us on a number of points, and have invariably found it correct and complete. In all there are some 15,000 or more English technical words selected carefully from all branches of technology, and in each case the equivalent French word or words are given. It is evident that the author has devoted great care to the selection of the English terms and to the collection of the various French words which express the different shades of meaning that may be attached to the English word or phrase in question. The volume now under review is the English-French part of the complete work, and we hope to receive for review, in due course, the corresponding French-English volume.

Trade Notes.

Sheet L311, which has just been issued by **B.T.-H. Co., Ltd.**, deals with Mazda Lamps and B.T.-H. Lighting Equipments, and gives a very comprehensive set of illustrations of the various types of lamps as well as shades, pendants and fittings for use therewith. It should, therefore, be of use to all installation contractors.

A neat, well-illustrated and very comprehensive 60-page catalogue of electrical accessories and sundries has just been issued by the **Sun Electrical Co., Ltd.**, of 120, Charing Cross Rd., London, W.C.2. It contains all the standard items which are likely to be required by an ordinary installation contractor from electric bells and bell wires upwards, and should, therefore, appeal to a very wide circle of readers, to whom it will be willingly sent on receipt of proper trade application.

A catalogue illustrating and describing the well-known Veeder Automatic Counters has just been issued by **Messrs. Markt and Co., Ltd.**, of 100, Clerkenwell Rd., London, E.C.1. It should prove of interest to all readers who have to make use of this class of machine.

A neatly-printed catalogue of electric fans for various purposes has just been issued by the **B.T.-H. Co.** and should be obtained by all electrical factors and installation contractors who wish to push these goods at the present season, when it is likely that there will be good business in them.

From the **Enterprise Electric Co.**, of Electric House, Grape Street, Shaftesbury Avenue, London, W.C., we have received a copy of their advance sheet No. 80 showing the net prices of their electric fans of various types. Trade readers should make a point of applying for copies without delay.

Fluxite, Ltd., of 62, Bevington Street, Bermondsey, London, who are so well known as the makers of the fluxite soldering paste, have just issued a new leaflet, in which they describe another use for this paste, namely, for case hardening and hardening and tempering tools. By its use, these processes are carried out cleanly and expeditiously, and the makers claim that the result is a beautiful, bright, glass-hard surface, free from scale and uneven patches, and, what is more, that the case-hardening when done in the Fluxite way goes deeper than by other methods. They will be pleased to send a copy of the circular and full particulars to any and every reader of this paper who cares to write a card applying for same.

A new leaflet dealing with their well-known No. 500 Inspection Lamp has just been issued by **Messrs. J. J. Eastick and Son**, of 2, St. Dunstan's Hill, London, E.C.3, and will be sent willingly to any reader who cares to apply for same The Inspection Lamp is one for which they are finding a very steady demand in all parts of Great Britain and the Colonies.

The June issue of the *Asea Journal* issued by the **Swedish General Electric Co., Ltd.**, of 5, Chancery Lane, London, W.C.2, contains an interesting account of the electrification of the Iron Ore Railways in Lapland, together with illustrations of the track and plant, as well as an illustration and description of the new locomotives which have been made by the company for the Riksfrans Railway. The issue should appeal to all readers who are in any way associated with railway electrification, and we recommend application to the company for copies.

A good business-pulling wall sheet has just been issued by the **Midland Electric Mfg. Co., Ltd.**, of Birmingham, and should prove a very attractive asset to electrical factors, wholesalers, etc., because on a fine, well varnished surface it gives a series of excellent illustrations of the leading "M.E.M." lines, together with list prices in a form which can be read at a glance, and may, therefore, be referred to with the least possible delay: an important point when a contractor client is in a hurry to decide on his materials before placing an order. The list is accompanied by a leaflet setting forth in simple language ten reasons why electrical wholesalers sell M.E.M. gear, any one of which should go a long way to convince all who are not already on the company's books of the wisdom of becoming customers without undue delay. Meantime, they should apply promptly for this new wall sheet in the ordinary way of trade.

By paying close attention to the sometimes drab here-present, you probably increase your chances for a bright hereafter.

Various Items.

Get It.—Reader, if you are interested in Automatic Telephony, write to the Relay Automatic Telephone Co., Ltd., at Marconi House, W.C.2, and ask for Booklet No. 7. It is worth reading.

Wireless.—A Mr. Jack Fairbrother, of Liverpool, has invented a one-valve set, on which he claims to be able to receive all B.B. stations, under normal conditions, and Paris under favourable conditions, on standard P.M.-G. aerial. He can also effectively cut out all unwanted stations at will.

Denmark.—The report on the economic situation of Denmark has just been issued by the D.O.T., and may be obtained from H.M.S. Office or ELECTRICITY office, price 2s. 2d., post free. It contains various articles of interest to electrical manufacturing firms who wish to increase their export trade with that country.

Visit of Overseas Electrical Engineers, July, 1924.—Members of the Institution of Electrical Engineers who wish to be present at the luncheon to be given to the Overseas delegates at the Hotel Cecil, on Thursday, July 10, at 1.15 p.m., are reminded that they should make early application for tickets as the lists will be closed within the next few days.

Decimals.—The *Decimal Educator* for June (price 6d.) contains a full programme of the important Conference on July 9, in addition to numerous articles on the disadvantages arising from our present weights, measures and coinage. It also contains an interesting report of a meeting of the Metric Association in the United States of America, as well as some problems which should be of interest to young people.

Personal.—We learn that Capt. C. H. J. Aldworth, M.C., following his recent resignation as manager of the *Electrician*, has now commenced business to provide Advertising Service. He is specialising in Postal Publicity, including the planning of Campaigns, preparation and printing of Advertising Literature and the production of Facsimile Letters. The style and address of the firm is Aldworth, Rolls House, Bream's Buildings, London, E.C.4. (Telephone: Holborn 4919.)

The Radio Association.—We have received from the Radio Association, of Sentinel House, Southampton Row, London, W.C.1, a copy of the regulations relating to the election of fellows and associates. Quite a large number of the readers of this paper are interested in radio and we can, therefore, recommend them to obtain particulars of the Association, as they might think of joining it. The Pesident is the Hon. Sir Arthur Stanley, C.B.E., C.B., M.V.O.

"20th Century Advertising."—The June issue of this excellent advertising monthly contains a large amount of matter of direct interest to all who are associated with publicity work, and should, therefore, be of value to everyone who is anxious to push trade. One item which will appeal to many advertisement men is the register of slogans which has been received by the editor of the magazine for the purpose of record. We can certainly recommend the magazine to our readers.

Tenders Accepted.—The G.E. Co., Ltd., have secured large orders for coloured sprayed Osram lamps for the decorative illumination of the "Sparrow Nest" Gardens at Lowestoft. They have also booked a contract from the Admiralty for Osram Traction lamps to be delivered to the various dockyards for use on H.M. ships.——The tender of the Siemens and English Electric Lamp Co. for twelve months' supply of Siemens Vacuum Type Lamps has been accepted by H.M. War Office.——The County Borough of Bootle have accepted the tender of the G.E. Co. for the supply of Osram lamps for the nine months commencing on July 1, 1924. The same company has also secured an order from the G.P.O. for 50,000 Telephone Switchboard Lamps.

Obituary.—We regret very sincerely to note that Dr. R. Mullineux Walmsley, S.Sc., who has been the principal of the Northampton Polytechnic Institute since 1895, has met his death through being knocked down accidentally by a motor-car just close to his own home in the Camden Road, on Friday, June 13. He passed away in the Royal Northern Hospital on Sunday, June 15, and the funeral took place on Thursday, the 19th, the service being held at 11 a.m. at St Luke's Church, West Holloway, followed by a committal service at the Golders Green Crematorium. It is indeed a sad loss to the electrical profession, and it will be felt very keenly by all who knew him personally, as he has undoubtedly educated a very large number of the electrical engineers who are now holding honourable positions in our great profession.

Oil Fuel for Central Heating.—An interesting lecture on this subject was delivered at the summer meeting of the Institution of Heating and Ventilating Engineers at the Langham Hotel, Regent Street, on Tuesday, the 24th inst., by Mr. A. F. Baillie (of Shellmex, Ltd.). The lecture was illustrated by various lantern slides, and was much appreciated by all present.

Sports.—The Siemens Sports Club held their second annual sports gathering on Saturday, the 21st instant, on their ground at Park Lane, Charlton, when a long programme was carried through very successfully under ideal conditions. The Sports Ground, which is naturally picturesque, was made festive by the addition of several marquees and a fine display of bunting. Over 10,000 people were present during the afternoon. The prizes were distributed by the Rt. Hon Sir William Bull, Bart., M P., one of the Vice-Presidents, and other Vice-Presidents present were Sir Walter R. Lawrence, Bart., G.C.I.E., G.C.V.O., C.B., and W. O. Smith, Esq. Callender's Cable Works Band greatly added to the success of the gathering.

Quotations Wanted.—The Dunedin (N.Z.) Corporation invite tenders for the supply and delivery of one synchronous condenser.——The New Zealand Department of Public Works at Wellington are inviting tenders for the supply and delivery of one 30-ton electrically operated overhead travelling crane required at Lyttelton.——The City of Toronto, Department of Works (Sewer Section), is inviting tenders for the supply and installation of two centrifugal sewage pumps, direct connected to electric motors.——The same Dept. also invites tenders for the supply and installation at the Main Sewage Pumping Station, Eastern Avenue, Toronto, one centrifugal sludge pump, direct connected to a variable speed induction motor, of not less than 50 h.p., including sales tax, duty, etc., and all necessary piping, shafting, etc. Specifications, etc., from the D.O.T. (Room 52), 35, Old Queen Street, London, S.W.1.

Brookhirst and the I.M.E.A.—During the recent I.M.E.A. Convention at Chester about one hundred members went through the works of Brookhirst Switchgear, Ltd., in two's and three's at a time, and were thus able to obtain an excellent idea of the company's manufacturing facilities and of the several new designs of electric control gear which have recently been placed upon the market. As Brook, Hirst and Co., this firm commenced the manufacture of switchgear in 1898 with a staff of *twelve!* Now the works will accommodate a normal staff of 500, engaged in the persistent following of the "Brookhirst" principle that motor-starting switchgear should include (1) complete protection for the motor against breakdown; (2) provision against the possibility of shock to the operator, and (3) that all the components for the control of a single motor should be embodied in one ironclad unit. We have no doubt that those who were able to spare the time to visit the works were amply repaid for their trouble.

GRINDERS
DRILLS
"DEPENDABLE"
& POLISHING LATHES
MARRYAT & PLACE, ENGINEERS.
28 HATTON GARDEN, E.C.2.

Sample Pair Sent on Approval for 8/6
Made of Pure Para Rubber soft and durable and unaffected by climatic conditions
DAVID MOSELEY & SONS,
Limited,
ARDWICK. MANCHESTER.
MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

JULY 4, 1924.

CONTENTS. PAGE

The "Chloronome" Process 343
A New Instrument for Recording Voltage Surges on Transmission Lines 344
Variable Speed A.C. Commutator Motors 345
Industrial Cinematograph Films 346
Current Topics 349
An Invitation 351
Questions and Answers by Practical Men 351
Some Notes on the Electro-Galvanising of Wire 352
The G.E.C. Sports 353
Various Items 354

THE "CHLORONOME" PROCESS.

(FROM A CORRESPONDENT.)

The past five years has shown an amazing development in scientific methods as applied to the operation of electricity stations and large steam and power plants in general. This has been very largely confined to steam generation, since the most favourable opportunities for economy occur on these lines in comparison with the utilisation of steam. As typical of the progress made, we have the great increase in boiler pressure and size of water-tube boilers, air heating, pulverised fuel, mechanical stokers with compartmented air supply, suspended firebrick arches, enabling single stokers up to 24 ft. wide to be constructed, "degassing" plant for the prevention of corrosion, and duplex flue gas analysing machines.

There has now been produced, however, by the Paterson Engineering Co., Ltd., of London, a highly ingenious apparatus, the "Chloronome," which they claim results in a very great economy in the consumption of steam by the turbines. The principle consists essentially of an arrangement for admitting continuously and automatically a minute trace of chlorine gas (usually not more than one-third part per million) to the condenser cooling water, so as to prevent the development of the organic growths which foul the condenser tubes and reduce the heat transmission efficiency, with corresponding reduction in the vacuum.

The importance of the continuous maintenance of the highest vacuum in steam turbines does not need to be emphasised, and a drop of 1 in. results in over 5 per cent. increase in the steam consumption. The vacuum obtained depends not only on the temperature and volume of cooling water, but also the extent of the fouling of the condenser tubes by the growth of microscopic organisms, which form a slimy and tenacious coating possessing very distinct heat insulating properties. The usual method adopted of trying to cope with this difficulty is to clean the tubes laboriously by using stiff brushes and rods, which is a troublesome and costly process, necessitating also extra condenser capacity to compensate for the loss of time. Thus, in one London power station (Borough of Hackney Electricity Department), where exact details have been taken, the average cost in labour for cleaning condenser tubes was £5 8s. per week for a 6,000 kw. generating set. When the "Chloronome" apparatus was installed, less than one-third part of chlorine was required per million parts of water to keep the tubes continually in a clean condition in spite of contamination by sewage, and the exact weekly cost of the treatment is: chlorine, which costs about 4d. per lb., £1 9s.; skilled attention, 5s.; and capital charges and repairs 15s., making a total of £2 9s., that is a saving of £2 19s. per week as compared with the previous cost of labour £5 8s. for hand-cleaning. This figure, however, is only a minor matter in comparison with the reduced steam consumption of the turbine, because of the maintenance of the highest vacuum. This works out for the 6,000 kw. set at no less than £28 10s. per week, with coal at 23s. 3d. per ton, in addition to the fact that less circulating water is necessary.

The "Chloronome" apparatus for the treatment of very large volumes of water, say, from 2,000,000 to 75,000,000 gallons per 24 hours, is of the "Manometer" type, in which the requisite number of cylinders of chlorine are connected by means of small bore flexible copper connecting pipes to a control board. The chlorine gas passes through a special filter and a stop-valve for adjusting the flow of the gas, whilst there is also included a pressure gauge which indicates the pressure of the chlorine in the cylinders, two reducing valves in series, and a meter to indicate the flow of the gas, which is bubbled through a patent acid seal isolating the chlorine gas from the water until this point is passed. The gas on emerging from the seal then passes to the bottom of a vertical absorption tower made of glazed earthenware, packed with pumice stone, in the top of which is a constant small spray of water. The chlorine gas, struggling up through this mass of wet material, is completely absorbed, and the water, containing all the chlorine in the form of a dilute solution, passes out of the bottom of the tower in a continuous stream and directly into the main water supply flowing to the condensers.

A table of operating constants is supplied with the apparatus, and, as a typical example for a large plant, 1,200,000 gallons of cooling water per hour at ¼ parts of chlorine per million, requires 3 lb. of chlorine per hour. The table gives all the conditions between 10,000 to 5,000,000 gallons of water per hour at rates of ¼ to 1 parts of chlorine per million, and the correct amount is soon found by experiment. Over 20 power stations in Great Britain are now equipped on these lines, and the same principle is being rapidly applied to the sterilisation of drinking water, several hundred "Chloronomes" being already in operation for this purpose.

THE SHORT-CIRCUIT COURT.

A man was arrested for assault and battery and brought before the magistrate.

Magistrate (to prisoner): What is your name, your occupation, and what are you charged with?

Prisoner: My name is Sparks, I am an electrician, and I am charged with battery.

Magistrate: Officer, put this guy in a dry cell.

A NEW INSTRUMENT FOR RECORDING VOLTAGE SURGES ON TRANSMISSION LINES.

A new instrument, known as the Klydonograph, has been developed by J. F. Peters, of the Westinghouse Electric and Manufacturing Co., for recording abnormal voltages on transmission lines. With this instrument a graphic record of voltage surges of extremely short duration can be obtained, giving their polarity, magnitude, steepness of application, etc.

Heretofore, because of the many peculiarities in connection with abnormal voltages such as surges or high-frequency oscillations, it has been difficult to obtain detailed information concerning them. Their cause is quite often not known, and their duration is generally so short that it has been practically impossible to measure with certainty their magnitude or duration. The result is that the knowledge of surges and abnormal voltages on transmission lines is rather limited, leading to questionable conclusions about their cause, effect and remedies.

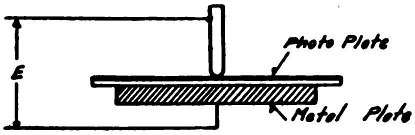


Fig. 1.—Diagram Drawing of a Simple Klydonograph.

The new instrument is based on an old principle first observed in 1777 by Dr. Lichtenburg, and makes use of figures known as Lichtenburg figures. Dr. Lichtenburg found that, if he discharged a condenser, such as a Leyden jar, across a spark gap on to a terminal in contact with an insulating plate placed between this terminal and a ground plate, and then removed the terminal and sprinkled powder on the plate, the powder would arrange itself in a figure that had a very peculiar appearance. In 1888 J. Brown and E. Trouvelot found that, with the insulating plate replaced by a sensitised photographic plate, the emulsion in contact with the terminal, figures very similar to those of Lichtenburg were created and appeared upon development.

The Klydonograph in its simplest form is indicated in Fig. 1. The photographic plate, of course, must be in a dark box. If a voltage is impressed between the terminal and the ground plate, as at *E*, on developing the photographic plate, figures will appear that will give pertinent information concerning the nature of the voltage impressed. If, for instance, the voltage is in the form of a surge that is undirectional, with a sheer front or a tapered front, the figure of the photographic plate will differentiate between the tapered front and the abrupt front, and it will also indicate whether the surge was of positive or negative polarity. The diameters of the figures also give a measure of the magnitude of the surges, although the positive and negative figures have quite different calibrations, the figure for the positive surge being considerably larger than that for the negative surge of the same magnitude.

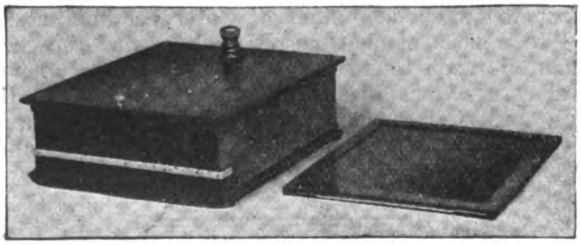


Fig. 2.—Klydonograph Operated by a Clock, for Practical Application.

For practical application, the instrument is made continuously operative, and is capable of recording the exact time of the occurrence of the disturbance. Fig. 2 shows a Klydonograph suitable for such application. This instrument makes use of a 10- and 12-inch plate in a special plate holder. The moving parts are driven by a clock that makes one complete revolution in 24 hours. Fig. 3 shows a method of connecting the Klydonograph to the line. Since this instrument is practically a zero current device, it is possible to connect it to the line electrostatically. This makes it possible to connect to a high voltage line without introducing an insulation hazard. With the Klydonograph connected as shown in this figure, the figures produced give the magnitude and polarity of the surges.

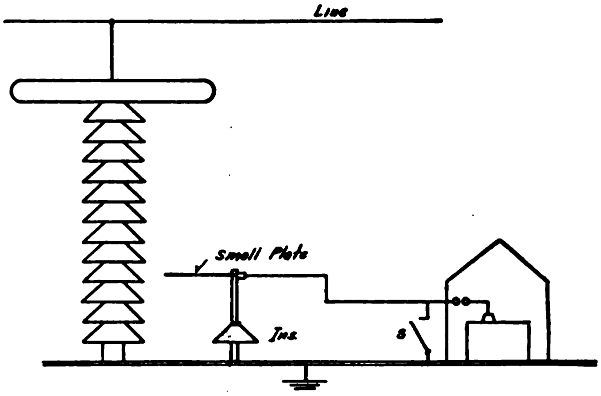


Fig. 3.—Method of Connecting the Klydonograph to the Line.

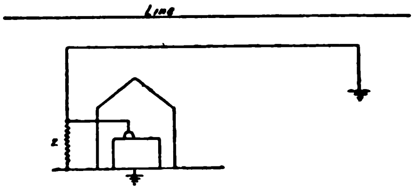


Fig. 4.—Method of Connection That Will Give the Steepness of the Surge Front.

Fig. 4 shows a method of connection that will give the steepness of the surge front. A counterpoise is run underneath or alongside the transmission line for 1,000 or 2,000 feet, with the far end grounded directly and the near end grounded through a high impedance. The Klydonograph is then connected across this high impedance to ground. The voltage induced in the counterpoise is a measure of the steepness of the current wave, and since the current wave and the voltage wave have exactly the same shape, it gives a measure of the steepness of the surge front. By comparing simultaneous readings of the Klydonographs, one connected to the line through the electrostatic potentiometer and the other to the counterpoise, the following information concerning the surge can be obtained: magnitude, polarity, steepness of front, and the direction in which the surge is travelling on the transmission line. Magnitude and polarity are obtained directly from the first Klydonograph, steepness of front directly from the second, and from the relative polarity of the two figures the direction in which the surge is travelling is obtained—that is, if the polarity of the two figures is the same, the surge is of the same polarity, and is travelling in a direction fixed by the manner in which the recorders are connected to the system. If the figures are of different polarity, the surge is of the polarity indicated by the recorder connected to the potentiometer, and is going in the opposite direction to the one previously mentioned.

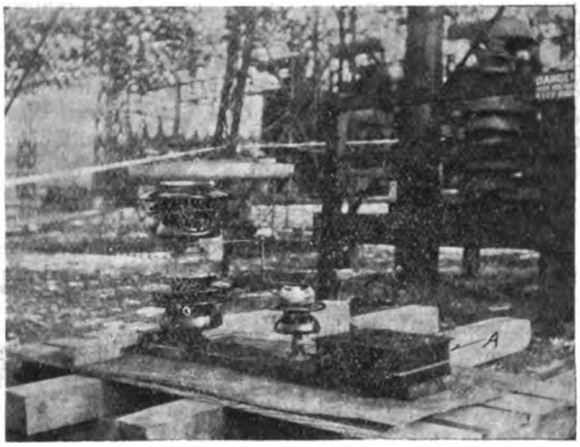


FIG. 5.—TEMPORARY SET-UP USED FOR SHORT-CIRCUIT TESTS ON A 22,000-VOLT SYSTEM.

FIG. 6.—FIGURE MADE BY A POSITIVE SURGE WITH AN ABRUPT FRONT.

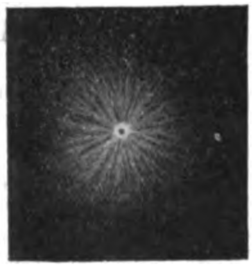


FIG. 7.—A NEGATIVE SURGE WITH AN ABRUPT FRONT.

Fig. 5 shows a temporary set-up that was used in connection with some short circuit tests on a 22,000-volt system.

"**Atkins' Manual, 1924.**"—The new edition of this most useful financial work has just been issued by Messrs. G. D. Atkins, the well-known stockbrokers, of 1, Drapers Gardens, London, E.C.2 It is printed on rubber latex paper, and contains an enormous amount of detailed information in regard to the various limited liability undertakings which are in any way associated with the electrical industry. In all it contains 432 pages, and should prove a most reliable and valuable work of reference for all who have anything to do with the finance of our industry.

VARIABLE SPEED A.C. COMMUTATOR MOTORS.*

By H. DREGHORN, B.Sc.

(*Concluded from page* 334.)

Another effect of brush shift is to increase the torque given at starting, and also the maximum torque of the machine, since the secondary current and the flux are brought into better relationship with each other.

One of the limiting features of this type of motor is the voltage permissible between the segments of the commutator. This voltage is short circuited by the brushes on the commutator, and therefore it must be small in magnitude. This voltage, as already mentioned, depends on the flux, the number of turns between segments, and the supply; and as the number of turns cannot be less than one, the flux per pole must be small, and hence the output of the motor per pole must be small. However, with specially-designed windings it has been found possible to increase the flux, and the output per pole is steadily increasing. Again it is evident that the lower the frequency, the greater output per pole is possible. For a 50-cycle system, a 150-h.p. motor, with a speed range of 680/220 R.P.M., has been built, and gave sparkless commutation at 100% overload, while at the present moment a 600-h.p., 14-pole, 25-cycle motor with a speed range of 320/107 R.P.M. is under construction for a steel rolling mill.

The motor has an infinite number of no load speeds and curves, and any speed within the range can be obtained at any load between full and no load. The speed is controlled by turning the brush spindle, and this can be arranged to suit the application, so that the speed can be controlled at the motor or from a distance, just as desired. Remote control can be effected mechanically or electrically, the former by ropes and chains, and the latter by a small pilot motor.

The form of the speed torque curves is similar to those of the ordinary induction motor, and at starting with the brushes set to give the minimum speed, twice full-load starting torque is possible. An interesting and important feature arises here since it is possible to start up the machine with this torque without using secondary resistances. It will be remembered that for sub-synchronous speeds the commutator voltage opposes the secondary voltage, which is a maximum at standstill, so that at starting it is the difference of these two voltages which produces the secondary current, thus keeping the current of reasonable magnitude. Again, it is the difference of the E.M.F.s of the regulating and secondary windings that is reflected into the primary, so that while there might be twice full load secondary current, the current in the primary might not exceed 1¼ times the full load value. All the switchgear necessary then is an oil switch which is interlocked with the bottom speed position of the brush gear, and on closing same the motor will start up against twice full load torque, taking 1½ times full load current from the line.

The power-factor curves of this 80-h.p. motor at three different speeds show that at maximum speed the power factor is unity at full load, and remains at a high

---

* **Paper read recently before the Birmingham and District Electric Club.**

A NEW INSTRUMENT FOR RECORDING VOLTAGE SURGES ON TRANSMISSION LINES.

A new instrument, known as the Klydonograph, has been developed by J. F. Peters, of the Westinghouse Electric and Manufacturing Co., for recording abnormal voltages on transmission lines. With this instrument a graphic record of voltage surges of extremely short duration can be obtained, giving their polarity, magnitude, steepness of application, etc.

Heretofore, because of the many peculiarities in connection with abnormal voltages such as surges or high-frequency oscillations, it has been difficult to obtain detailed information concerning them. Their cause is quite often not known, and their duration is generally so short that it has been practically impossible to measure with certainty their magnitude or duration. The result is that the knowledge of surges and abnormal voltages on transmission lines is rather limited, leading to questionable conclusions about their cause, effect and remedies.

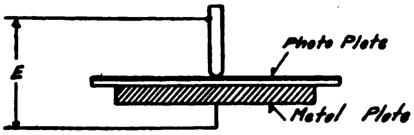


Fig. 1.—Diagram Drawing of a Simple Klydonograph.

The new instrument is based on an old principle first observed in 1777 by Dr. Lichtenburg, and makes use of figures known as Lichtenburg figures. Dr. Lichtenburg found that, if he discharged a condenser, such as a Leyden jar, across a spark gap on to a terminal in contact with an insulating plate placed between this terminal and a ground plate, and then removed the terminal and sprinkled powder on the plate, the powder would arrange itself in a figure that had a very peculiar appearance. In 1888 J. Brown and E. Trouvelot found that, with the insulating plate replaced by a sensitised photographic plate, the emulsion in contact with the terminal, figures very similar to those of Lichtenburg were created and appeared upon development.

The Klydonograph in its simplest form is indicated in Fig. 1. The photographic plate, of course, must be in a dark box. If a voltage is impressed between the terminal and the ground plate, as at E, on developing the photographic plate, figures will appear that will give pertinent information concerning the nature of the voltage impressed. If, for instance, the voltage is in the form of a surge that is undirectional, with a sheer front or a tapered front, the figure of the photographic plate will differentiate between the tapered front and the abrupt front, and it will also indicate whether the surge was of positive or negative polarity. The diameters of the figures also give a measure of the magnitude of the surges, although the positive and negative figures have quite different calibrations, the figure for the positive surge being considerably larger than that for the negative surge of the same magnitude.

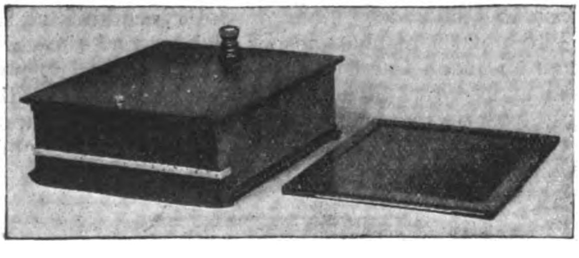


Fig. 2.—Klydonograph Operated by a Clock, for Practical Application.

For practical application, the instrument is made continuously operative, and is capable of recording the exact time of the occurrence of the disturbance. Fig. 2 shows a Klydonograph suitable for such application. This instrument makes use of a 10- and 12-inch plate in a special plate holder. The moving parts are driven by a clock that makes one complete revolution in 24 hours. Fig. 3 shows a method of connecting the Klydonograph to the line. Since this instrument is practically a zero current device, it is possible to connect it to the line electrostatically. This makes it possible to connect to a high voltage line without introducing an insulation hazard. With the Klydonograph connected as shown in this figure, the figures produced give the magnitude and polarity of the surges.

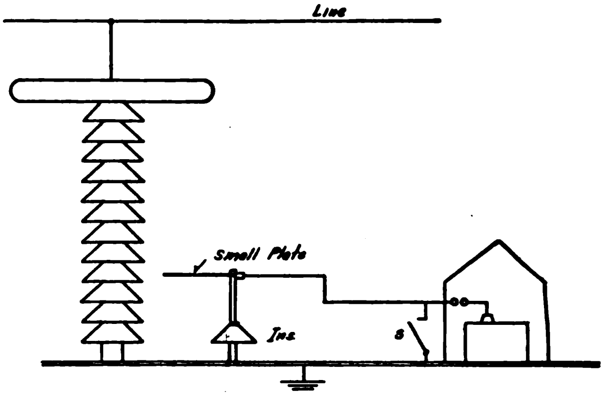


Fig. 3.—Method of Connecting the Klydonograph to the Line.

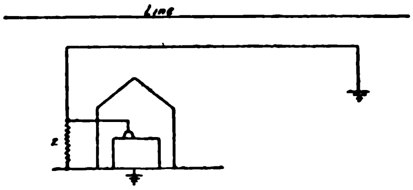


Fig. 4.—Method of Connection That Will Give the Steepness of the Surge Front.

Fig. 4 shows a method of connection that will give the steepness of the surge front. A counterpoise is run underneath or alongside the transmission line for 1,000 or 2,000 feet, with the far end grounded directly and the near end grounded through a high impedance. The Klydonograph is then connected across this high impedance to ground. The voltage induced in the counterpoise is a measure of the steepness of the current wave, and since the current wave and the voltage wave have exactly the same shape, it gives a measure of the steepness of the surge front. By comparing simultaneous readings of the Klydonographs, one connected to the line through the electrostatic potentiometer and the other to the counterpoise, the following information concerning the surge can be obtained: magnitude, polarity, steepness of front, and the direction in which the surge is travelling on the transmission line. Magnitude and polarity are obtained directly from the first Klydonograph, steepness of front directly from the second, and from the relative polarity of the two figures the direction in which the surge is travelling is obtained—that is, if the polarity of the two figures is the same, the surge is of the same polarity, and is travelling in a direction fixed by the manner in which the recorders are connected to the system. If the figures are of different polarity, the surge is of the polarity indicated by the recorder connected to the potentiometer, and is going in the opposite direction to the one previously mentioned.

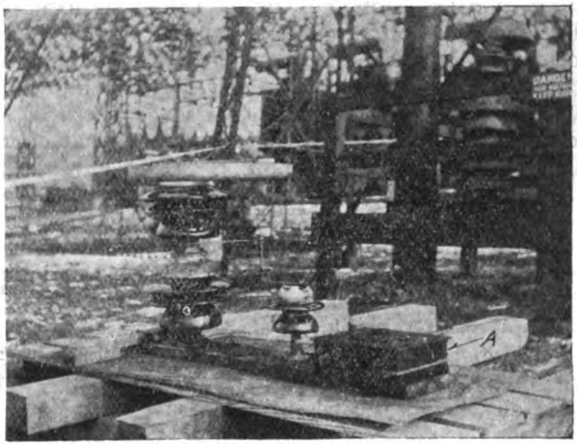


FIG. 5.—TEMPORARY SET-UP USED FOR SHORT-CIRCUIT TESTS ON A 22,000-VOLT SYSTEM.

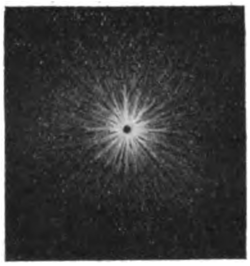


FIG. 6.—FIGURE MADE BY A POSITIVE SURGE WITH AN ABRUPT FRONT.

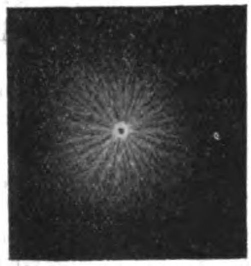


FIG. 7.—A NEGATIVE SURGE WITH AN ABRUPT FRONT.

Fig. 5 shows a temporary set-up that was used in connection with some short circuit tests on a 22,000-volt system.

"**Atkins' Manual, 1924.**"—The new edition of this most useful financial work has just been issued by Messrs. G. D. Atkins, the well-known stockbrokers, of 1, Drapers Gardens, London, E.C.2 It is printed on rubber latex paper, and contains an enormous amount of detailed information in regard to the various limited liability undertakings which are in any way associated with the electrical industry. In all it contains 432 pages, and should prove a most reliable and valuable work of reference for all who have anything to do with the finance of our industry.

VARIABLE SPEED A.C. COMMUTATOR MOTORS.*

By H. DREGHORN, B.Sc.

(*Concluded from page* 334.)

Another effect of brush shift is to increase the torque given at starting, and also the maximum torque of the machine, since the secondary current and the flux are brought into better relationship with each other.

One of the limiting features of this type of motor is the voltage permissible between the segments of the commutator. This voltage is short circuited by the brushes on the commutator, and therefore it must be small in magnitude. This voltage, as already mentioned, depends on the flux, the number of turns between segments, and the supply; and as the number of turns cannot be less than one, the flux per pole must be small, and hence the output of the motor per pole must be small. However, with specially-designed windings it has been found possible to increase the flux, and the output per pole is steadily increasing. Again it is evident that the lower the frequency, the greater output per pole is possible. For a 50-cycle system, a 150-h.p. motor, with a speed range of 680/220 R.P.M., has been built, and gave sparkless commutation at 100% overload, while at the present moment a 600-h.p., 14-pole, 25-cycle motor with a speed range of 320/107 R.P.M. is under construction for a steel rolling mill.

The motor has an infinite number of no load speeds and curves, and any speed within the range can be obtained at any load between full and no load. The speed is controlled by turning the brush spindle, and this can be arranged to suit the application, so that the speed can be controlled at the motor or from a distance, just as desired. Remote control can be effected mechanically or electrically, the former by ropes and chains, and the latter by a small pilot motor.

The form of the speed torque curves is similar to those of the ordinary induction motor, and at starting with the brushes set to give the minimum speed, twice full-load starting torque is possible. An interesting and important feature arises here since it is possible to start up the machine with this torque without using secondary resistances. It will be remembered that for sub-synchronous speeds the commutator voltage opposes the secondary voltage, which is a maximum at standstill, so that at starting it is the difference of these two voltages which produces the secondary current, thus keeping the current of reasonable magnitude. Again, it is the difference of the E.M.F.s of the regulating and secondary windings that is reflected into the primary, so that while there might be twice full load secondary current, the current in the primary might not exceed 1¼ times the full load value. All the switchgear necessary then is an oil switch which is interlocked with the bottom speed position of the brush gear, and on closing same the motor will start up against twice full load torque, taking 1½ times full load current from the line.

The power-factor curves of this 80-h.p. motor at three different speeds show that at maximum speed the power factor is unity at full load, and remains at a high value over a wide range of load and speed. The efficiency curves of the same motor show that even at a third of the maximum speed the efficiency is still very high. Reference has already been made to the method of obtaining speed variation by inserting resistance in the secondary of induction motors. While with the induction motor the input at all speeds is the same, the commutator motor takes power only in proportion to the output. On a commercial duty, tests have been taken over a lengthy period recording the power taken by the commutator motor and by an induction motor with rotor control driving duplicate machines under exactly the same conditions, when it was found that the power taken by the former was barely 50% of the latter. In some applications, creeping or inching speeds are necessary for short periods, and these can be obtained by inserting small resistances in the secondary phases.

---

* Paper read recently before the Birmingham and Dis
Electric Club. the Royal [illegible] rs,

This motor, then, which has the necessary characteristics of a truly variable speed motor in that all speeds within the range can be obtained, and also that the speed is independent of the load, is admirably suited for any duty where the operating conditions demand these features. The speed of the motor passes under control through every revolution of its speed range, and thus uniform and gradual acceleration is obtained. This feature has rendered the motor particularly successful in paper manufacture, paper printing, calico printing, and also in the production of textile materials. Recent tests taken on rotary printing presses driven by 50-h.p. equipments showed a saving in the power bill of approximately £150 per annum over an induction motor with rotor resistance speed control. There was also a saving of about 25% in time over the induction motor, due to the rate of acceleration of the motor being practically independent of load. In the case of the induction motor the grading of the resistances had to be suitable for all conditions of loads, and so on heavy loads the time to accelerate the press to printing speed was much greater than on light loads.

This commutator motor has also met with unqualified success in driving hydraulic pumps where a constant pressure with a varying demand is required. An accumulator works in conjunction with the pump, and its rise and fall lowers and raises the speed of the motor automatically, thus maintaining maximum storage capacity without frequent and objectionable starting and stopping of the motor.

In the field of machine tool drives this motor has also proved its worth, particularly on large wheel lathes where it is desired to decrease the speed when hard parts of the tyres are being machined.

Other applications in an unlimited number include centrifugal pumps, fans, paper calenders, ring spinning, boiler stokers, elevators, sugar refining machinery, etc. Machines of this type totalling an output exceeding 5,000 h.p. have now been built in this country, and in every case most satisfactory results are being obtained.

Automatic Telephone Dial Folder.—A cut-out folder has been issued by **Siemens Bros. and Co., Ltd.**, of Woolwich, in the form and size of their Automatic Telephone Dial, the obverse and reverse showing the front and back of the dial respectively. ustrations are given on the inside pages of table and wall ern telephones, and also of a 100-line Automatic Exchange.

INDUSTRIAL CINEMATOGRAPH FILMS.

It is fairly safe to say that the average man is totally ignorant of the processes involved in the making of articles of daily use. Take, for example, such things as cotton, electric lamps, tinplate, steel wire, etc.; the operations involved in the manufacture of these things are full of interest, but are known to very few outside the actual industries concerned. It is, of course, impossible to carry out all such operations at the Wembley Exhibition, as they relate to industries which can only be conducted on a large scale. The Department of Overseas Trade, however, are showing many scenes of intense interest connected with various industries by means of a series of industrial films, which they are exhibiting in the Government Pavilion at Wembley.

Each industry selected is covered by a short film of about fifteen minutes' duration, so arranged as to include clearly all the essential operations. For instance, the incandescent electric lamp is dealt with by a film entitled "The Magic of Modern Lighting," showing the making of vacuum and gasfilled lamps, and including such interesting scenes as glass blowing, filament winding, bulb exhausting, etc. Others illustrate the weaving of cotton in a Lancashire cotton mill, the manufacture of tinplate, and the rolling of steel rod and wire in a Yorkshire steel rolling mill; while yet another, dealing with the production of iron ore, is of particular interest, as showing the application of electricity in connection with locomotives and other underground equipment. As an additional point of interest in connection with this particular film, we believe it was the first cinematograph film to be taken underground in this country.

"The Electrically Propelled Ship" is another film which deals with one of the latest developments in marine engineering. In addition to showing the ship being launched and setting out on her trials, it includes views in the foundry and machine shops, showing various stages in the manufacture of the turbo-electric equipment, and also shipyard scenes showing plate working etc.; while "The Building of a 40,000 h.p. Turbo-Generator" covers briefly the various manufacturing operations involved in the production of the largest turbo-generator which has so far been installed in the British Empire. In addition to showing scenes in the foundry and machine shops, the film shows the erection of this gigantic machine on site in the Rotherham Power Station, and finishes with the official starting up by H.R.H. the Prince of Wales.

The foregoing does not indicate by any means the entire field covered by the Department of Overseas Trade exhibition, but covers the section of particular interest from an engineering point of view, in that all the films referred to have been produced by arrangement with the British Thomson-Houston Co., Ltd., who have for a good many years utilised the cinematograph for both recording and educational purposes, and the short versions being shown at Wembley have been selected from the many comprehensive films which they have taken from time to time in connection with the installation of their plant in various industries.

It isn't practicable in politics to fight a Bolshevist with perfumery.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of
CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N. 17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application, Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

The Pot and the Kettle.

The recent Birmingham controversy, and Mr. Beale's accusation of profiteering against certain firms which are members of the very honourable B.E.A.M.A., has its humorous side, inasmuch as there is probably no municipal body of any magnitude which has not at some time or other deliberately cooked its accounts for the delectation of the ratepaying and voting community whose interests it is supposed to study. Figures, and especially municipal balance-sheets, can be made to show any desired result within reason, and many a pretty plot has been evolved within the council chamber with a view to making black appear yellow, or four beans to appear in the public gaze as five. When experienced councillors and aldermen have control of the finances of a big city it is a perfectly simple matter to subsidise an unprofitable undertaking with the aid of profits drawn from another municipal scheme, and I defy certain municipalities, which shall be nameless, to deny that this has been done repeatedly in the past, and is, moreover, still a current practice where local politics indicate the desirability.

In the circumstances it is rather amusing to find Birmingham criticising the existence of an ordinary trade association, the perfectly praiseworthy aims and objects of which are well known and above suspicion. I am glad Mr. Dunlop has taken up the cudgels on behalf of the B.E.A.M.A. The sooner this unfounded suspicion of the existence of a trade ring or trust is rooted out of the public mind the better for everybody. Like any other great city the Birmingham city fathers have every right to buy in the cheapest market and assure themselves of a fair deal, but in so doing they have no right to impugn the honesty of the electrical manufacturer in this country, whatever may be their views on Continental competition. I have a fairly intimate knowledge of the inner workings of most of the electrical trades associations, and I have no hesitation in stating that in no single instance do I know of a case of combination for the sake of keeping prices up or securing an undue margin of profit. On the face of it foreign competition is far too keen at the present or any other time to make such a policy worth while.

Shoddy Wiring.

I don't know whether the standard of workmanship is lower in London and district than it is in the provinces, but I do know from personal experience of several cases of very shoddy and criminally careless wiring at Wembley, for which the responsible contractor, or possibly the individual employed by him, deserves heavy censure. I refer more particularly to the incidental wiring carried out on certain of the exhibitors' stands by outside wiring firms employed by them. Only to-day my assistance was sought by the lady attendant of a certain stand to investigate the failure of two lamps in a three-light fitting. The incoming flex was of very indifferent quality, and had been wired into the first holder with an extension piece leading to the second and third holders respectively. I tried the lamps and found them O.K. On dismantling the holders I found that the extension flex had been badly kinked and pulled taut between the first and second lampholders, and, as a result, had broken inside the insulation on both poles.

On rewiring all three lampholders with flex of better quality, everything was restored to normal, but there was no earthly reason why a good job should not have been made of it at the outset. On trying the switch, an ordinary tumbler pattern, I again discovered trouble, the bridge piece refusing to strike the spring clips centrally and jamming instead of going home sweetly. This seems to be a common trouble on certain of the cheaper types of switch, and I have noticed the same difficulty on several other stands with switches controlling small groups of lights. Again, why is it that tubolite, or strip lamps, are so uncertain as to their lease of life? I know of at least three, used in connection with certain signs and show cases, which have given up the ghost within a few minutes of switching on for the first time. Possibly the very considerable voltage variation at the Wembley power station has something to do with it.

The Institution Conversazione.

The Kelvin Centenary Conversazione of the Institution of Electrical Engineers, held at the Natural History Museum, South Kensington, was a great success and was well attended, many visitors who do not usually favour us with their presence being in attendance, due to the Wembley magnet which has secured their presence in London at this juncture. One noticed many familiar faces, and I for one renewed acquaintance with old friends and colleagues I had not met for many years. In at least one instance I was reintroduced to a colleague in the profession whom I had lost sight of nearly thirty years ago. Recognition was mutual, although Jack Frost had been busy with both our coiffures in the ensuing interval. Excellent music was purveyed by the band of the Royal Engineers, which played in the main hall, whilst an enjoyable vocal and instrumental concert delighted a considerable audience in the Reptile Gallery, scarcely an appropriate venue for such charming lady vocalists as graced the platform.

Wembley and the Heat Wave.

Last week at Wembley was the hottest yet experienced, and there was a record sale of cooling fans as a natural consequence. The glass roofs, especially in the main avenues of the Palace of Engineering, concentrate the sun's rays on perspiring humanity, whether official or visiting, and a face which was not bedecked with beads of moisture or alternatively the colour of a ripe tomato was a rarity. One hears rumours that the administration are considering ways and means of alleviating the distress by partially obscuring the glass, and one can only hope that they will make up their minds and get on with the job before the heat wave is succeeded by the inevitable cold spell. It is admittedly no small job to paint or whitewash thousands of square yards of roof glazing, but it is one of those things that might with advantage have been taken in hand earlier in the season and before the sun attained its full summer strength.

Television.

An interesting advance in the problem of successful television is claimed by Mr. C. Mayer, who has concentrated on the perfect synchronisation of the photo-electric cells at the sending and receiving ends of the line respectively. The new invention is to be exhibited at the forthcoming Exhibition of the Institute of Patentees at 44, Great Russell Street in July, where readers who are interested in this fascinating problem which is rapidly nearing satisfactory solution will have an opportunity of examining it, although only in the form of drawings.

The Channel Tunnel.

It is highly satisfactory to note that this perennial project is again being actively revived under the ægis of the Rt. Hon. Sir William Bull and his Channel Tunnel Committee. As an ultra-conservative nation we are extremely slow to move or take any revolutionary initiative, but once we do get the ponderous fly-wheel in motion, we lose no time, and on this occasion the military objections to the scheme, which have served effectively to block its progress in the past, no longer hold good. From a military standpoint this country is no longer an island, although there are many estimable old gentlemen still living who will stoutly maintain that it is, quite irrespective of air raids and the like. A Channel tunnel would undoubtedly strengthen the entente, promote intertrading with the Continent and banish once and for all that horror of the Channel crossing which debars many worthy souls from venturing across our extensive coast line. I sincerely trust that on this occasion common sense will prevail and the scheme attain fruition.

Electrical Fires.

Since reprinting in last week's issue an extract from Dr. Waldo's Annual Report for 1923, he has favoured us with a complete synopsis of the recommendations of his committee which embody the invaluable experiences of fire prevention and life preservation gained by him during his many years office as Coroner for the City of London and Southwark. Dr. Waldo also advises us that appropriate posters are in course of preparation by the City Corporation and will be issued as soon as they are ready. The additional recommendations refer principally to the necessity for Fire Drills, precautions where smoking is allowed in business premises, celluloid dangers and adequate means of escape from premises in the case of outbreaks of fire. It is to be hoped that his excellent work in this connection will bear fruit in reducing the death rate directly due to fire in this country.

Electricity on the Farm.

The directing authorities of the Electrical Development Association are working wholeheartedly in their endeavours to push the uses of electricity in every possible way, and with this laudable object in view, they invited various members of the Press on Friday, June 27, to visit Mr. R. Borlase Matthews' farm at East Grinstead, and inspect the plant generally. It was a most interesting and instructive outing and thanks are due to our host and his staff for courtesies and information so willingly rendered. Practically everything on the farm is worked by electricity, current being obtained from a low-fall turbine-driven plant, using the upper waters of the River Eden at the top end of the farm. Incubators, farm machinery, milking, ploughing, etc., were all demonstrated, and we were very interested in the new high-discharge machine which is to be used for electro-culture with a view to increasing the crop yields. The engineering workshop was also inspected, and we were shown a special side line in the way of a cheap but wonderfully efficient wireless set which Mr. Borlase Matthews is placing on the market. I hope that the result of the publicity afforded by the visit will attract many visitors to the E.D.A. No. 2 exhibit at Wembley, where electricity on the farm is the special feature. After all, farming is the largest national industry, and as over 400 British farms are already using current in one form or another, I expect we shall find that the growth of the demand will be in an ever-increasing ratio. I hope so, most sincerely.

The N.A.S.E.

Those members of the National Association of Supervising Electricians who were able to attend the conference at Wembley on Saturday, June 28, were rewarded with glorious weather and at the same time were able to listen to several brief but eminently interesting and practical speeches at the short conference in the afternoon, when Mr. W. E. Highfield retired from the presidential chair, which he has so ably occupied, and inducted Mr. Frank Gill as the new president. The proceedings were of just that happy and sociable nature which one associates with this society. Mr. Highfield opened the conference with a few well-chosen words of welcome at what was, he said, their first meeting of this nature, and then went on to remark how their great aim was to raise the status of the supervising electrician. His vote of thanks to all who attended was duly seconded by Mr. Windibank in a capital speech, who said all members must aim at 100 per cent. efficiency, and must expect remuneration from the employers in accordance therewith. To him succeeded Mr. Brammer, the very much alive secretary, who remarked that this was the first time the N.A.S.E. members had got together in a national sense, and that, judging by the way things were going, the Board of Control had no reason to be afraid of the future. He also gave an able explanation of the term "Commercial Engineer," after which the outgoing president expressed his grateful thanks for the way in which he had always been supported during his term of office, and then retired in favour of Mr. Frank Gill, who was received with much applause on taking the chair.

The new president then called on Mr. Starke, a member from the wilds of Caledonia, who proposed a very hearty vote of thanks to Mr. W. E. Highfield for the way in which he had guided the Association, and worked for their common good during his presidency. He referred to the Highfield Shield and the Scholarships, and altogether gave a very clear exposition of the progress made under Mr. Highfield's rule, all of which was cordially applauded by those present. Mr. Highfield expressed his thanks in suitable terms, and said what a pleasure it was to him to work in their interests. Mr. Revell then proposed a cordial vote of welcome to the new president, for which he was duly thanked by Mr. Gill, who remarked that he felt certain he would have the sympathetic assistance of the Board of Control as well as of all the members. In conclusion, Mr. Brammer mentioned that Mr. Highfield had promised to act as examiner for the scholarships, and Mr. Naylor proposed a vote of thanks to the ladies who were present, which was carried with acclamation. Altogether a most successful meeting.

ELEKTRON.

AN INVITATION.

Visitors to Wembley who are interested in old-time electrical apparatus, are cordially invited to visit the stand of this paper, ELECTRICITY, in Bay 14, Avenue 15, in the Palace of Engineering (near the power station), and inspect the five historical incandescent lamps which are there on view. They are as follows:—

1 Original Swan Lamp
1 Original Edison Lamp,

both of which were in actual use at the Crystal Palace Electrical Exhibition in 1882. Also

1 Original Swan United Lamp
2 Original Khotinsky Lamps,

all three of which were in use at the Inventions Exhibition, South Kensington, in 1885. They are fixed in different lamp-holders of that period, one with a weird exterior switch, and there is also an old-fashioned fuse with brass cover. A Woodhouse and Rawson lamp is being added to the collection.

"**The Motor Ship.**"—In the July issue of this paper there are several articles of interest to electricians, including one on a new system of electrically-driven ships' auxiliaries, and another on the 1,500-ton cargo vessel *Majong*, which has a 700-h.p. semi-Diesel installation with electrical auxiliaries.

Removal.—Owing to the continued expansion of his business in armature winding and motor repairs, Mr. Samuel Baxter has had to remove to new and more commodious premises at 102, Greyhound Road, London, W.6, with works and goods entrance in Crefeld Road adjoining. His telephone number remains the same—Hammersmith 2524.

Benevolence.—A dinner and dance will be held at the Midland Hotel, Manchester, on Tuesday, October 21, 1924, in aid of the Electrical Trades Benevolent Institution, which all sections of the trade are earnestly invited to support. Further details will be published at a later date, or can be obtained from Mr. F. G. Quance, hon. secretary, Manchester and District Advisory Committee, E.T.B.I., Magnet House, Victoria Bridge, Manchester.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 184.

I would appreciate details of a three-phase 6,000-volt transmission system (overhead). What is the function of the guard wire? What type of earth plates are used? Is every lattice-type pole earthed, etc.?—"FREQUENCY."

QUESTION NO. 185.

I understand that every central station has a potentiometer for calibrating instruments. What are the advantages of this instrument for this purpose as compared with standard instruments?—"JUNIOR-SHIFT."

(*Replies to Questions Nos.* 184 *and* 185 *must be received not later than July* 26, 1924.)

Finance.—The balance-sheet of Edmundson's Electricity Corporation for the year ending March 31 last shows a very satisfactory improvement in income, and the directors propose the payment of a final dividend of 4 per cent. on the ordinary shares, making 7 per cent. per annum. £20,000 is carried to reserve and over £16,000 carried forward.

Quotations Wanted.—The Municipal Council of Johannesburg invite tenders for the supply of single-phase transformers and spares.——The State Electricity Supply Works at Montevideo invite tenders for special cables. Also for rubber insulated cords, and for 45,000 metres of two and three-conductor lead-covered 225-volt cable.——The management of the State Electricity Supply Works at Montevideo invite tenders for low tension and telephone cables.——The Electricity Department of Capetown Municipality invites tenders for the supply and delivery of various workshop appliances, including portable electric drills, oxy-acetylene welding and cutting plant, and motor generating arc welding plant. Specifications, etc., from the D.O.T. (Room 52), 35, Old Queen Street, London, S.W.1.

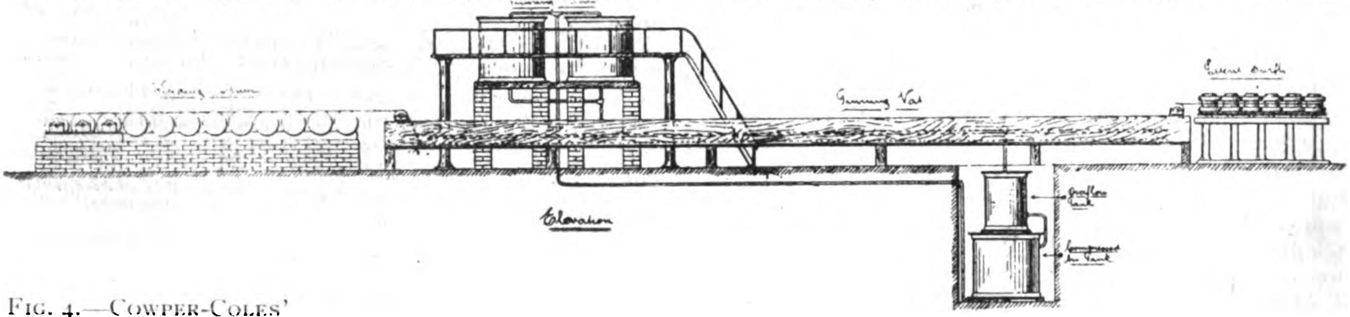
An Invitation.—Every reader of ELECTRICITY who visits the great British Empire Exhibition is most cordially invited to call at our (S. Rentell and Co., Ltd.) stand in Bay 14, Avenue 15, in the Palace of Engineering, close to the power station, and inspect our stock of technical books. Not only have we a splendid assortment of works on all branches of engineering science, both theoretical and practical, but we are also selling books on cycling, motoring, navigation, engine driving, installation work, wireless and, in fact, every subject which is likely to appeal to our many thousands of readers who may be employed in such works as collieries, cotton mills, shipyards, cable factories, telegraphs and telephones, aeroplane construction, chemical factories, etc. All are welcome, and if they will just say what they want we will do our best to give them catalogues dealing therewith. Leading publishers such as Griffin, Longmans, Percival Marshall, Reed, Pitman, Chapman and Hall, etc., have had lists printed especially for us to help our clients. So come along, all of you. We will do our best to please, and as we have been dealing in technical books for well over thirty years we have a really good knowledge of the business gained by actual experience

SOME NOTES ON THE ELECTRO-GALVANISING OF WIRE.

BY SHERARD COWPER-COLES.

(Concluded from page 340)

Fig. 4 and 5 (Patent No. 11547/1895) shows the Cowper-Coles apparatus for working in conjunction with his regenerative process of electro-zincing, that is to say, working with insoluble lead anodes and circulating the electrolyte through a regenerative tank containing granulated zinc, zinc dust or zinc residues mixed with granulated coke, which has the advantage of considerably reducing the working costs as no



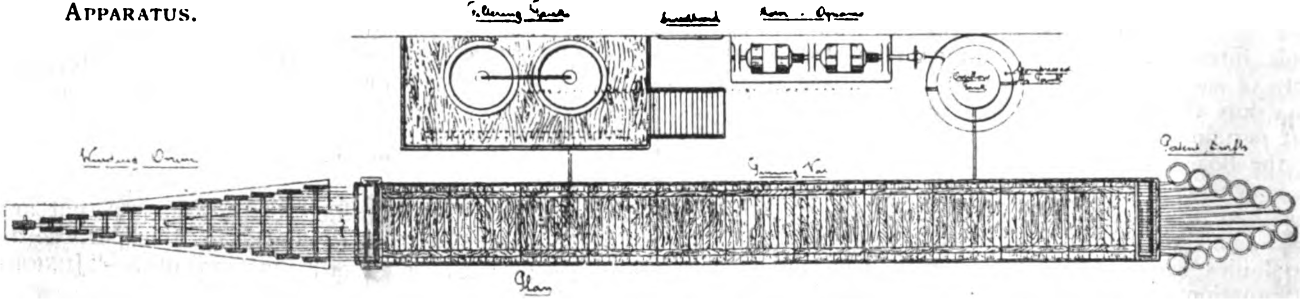


FIG. 4.—COWPER-COLES' APPARATUS.

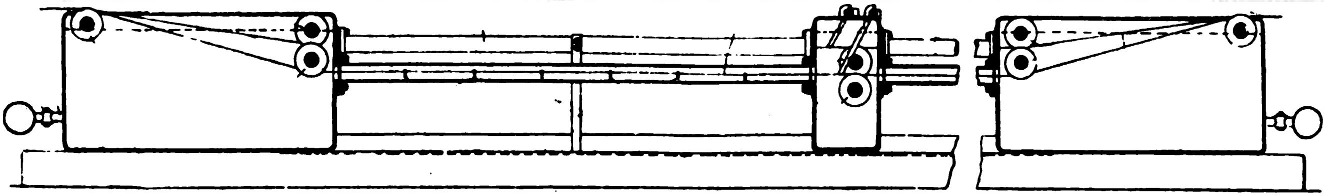


FIG. 5.—COWPER-COLES' PROCESS.

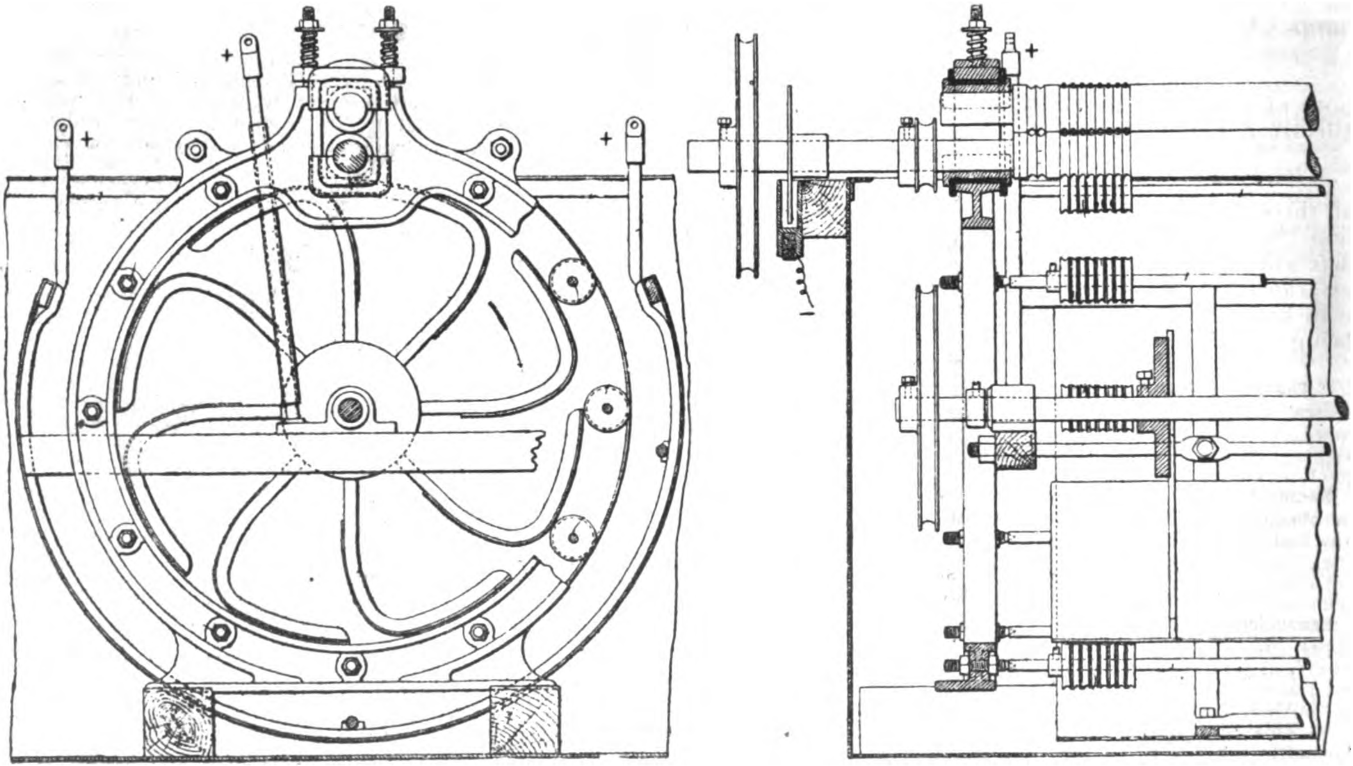


FIG. 6.—RAWSON'S APPARATUS.

special zinc anodes have to be cast and placed in position at short intervals, and there is no waste of zinc as in the case of zinc anodes.

Fig. 6 illustrates an apparatus devised by Rawson (Patent N. 6069/1896), the object of which is similar to Hemmings's and Wallace's, namely, to ensure a large quantity of wire being immersed in the solution, which he accomplished by having an insulated framework provided with longitudinal rods on which the wire is coiled so as to form a cylinder. A moving anode is provided inside the coiled wire and a stationary one outside. Such apparatus for continuous successful working is impracticable.

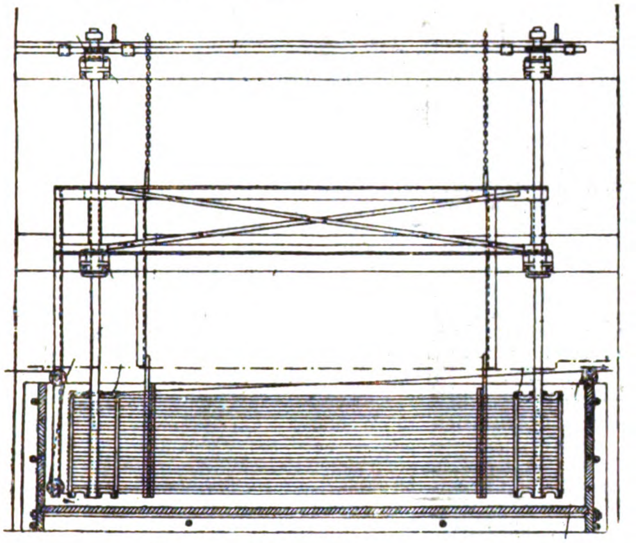


FIG. 7.—FEENEY'S APPARATUS

Feeney's Apparatus is shown in Fig. 7, patented in 1914 (No. 13699), and has the same object in view as that of Hemming's, Wallace's and Rawson's, viz., to obtain a long length in the depositing vat. To reduce the amount of metal deposited on the rollers over which the wire passes, partitions are provided at each end of the vat, which are shown in the illustration.

Several firms in England have spent considerable sums of money in trying to electro-zinc wire, but so far without commercial success—amongst whom may be mentioned Messrs. Richard Hill and Co., of Middlesbrough, and Messrs. Craddock, of Wakefield.

The essential conditions for a successful plant for electro-zincing iron and steel wire to compete in working costs and to produce a galvanised wire as saleable as the present hot-galvanised wire, must fulfil the follow conditions:—

(1) The process and apparatus must be such as to allow a high current density to be employed at a low voltage.

(2) The rate of production must be sufficiently quick to compare with the hot-galvanising process, so that the size of the plant may come within reasonable limits both as regards floor space and first cost.

(3) The zinc coating must be homogenous and free from all weak places.

(4) The zinc coating should be bright so as to compare favourably with hot-galvanised wire.

(5) The plant must be capable of being run continuous without a stop for a considerable period.

THE G.E.C. SPORTS.

We look forward each year to an annual visit to the Herne Hill Track to witness the sports organised by the General Electric Company, and it was with pleasure that we accepted an invitation to be present, at what is now an important sports fixture, on Saturday, June 28.

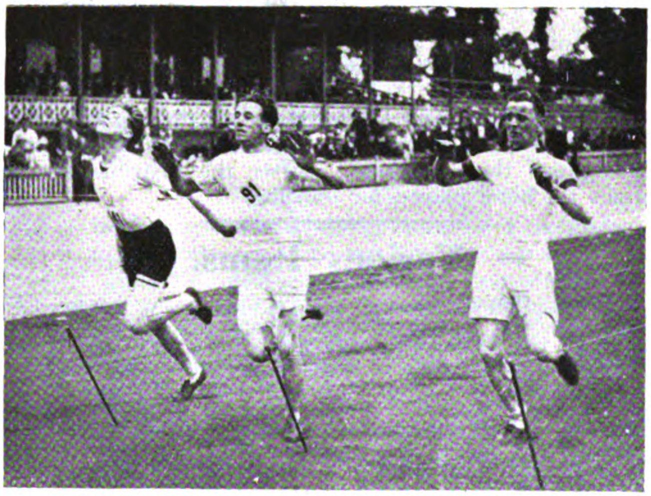
Before dealing with any of the events we would venture to suggest that this sports meeting is remarkable from the fact that no fewer than ten Challenge Cups are competed for, the events in connection with them being open to all works and branches of the G.E.C. These cups, in addition to a wealth of valuable prizes awarded to winners of other events, are significant of the interest the General Electric Company takes in their "family," and in the promotion of clean, healthy sport.

The chief results are as follows:—

100 YARDS—Final: G. S. Wheeler 1, E. G. Osborne 2, D. H. Young 3; yard, same; 11 3-5 sec.

100 YARDS (Senior)—Final: F. W. Dunkley, 7 yds., 1; H. J. Barron, 4, 2; W. C. Grant, $4\frac{1}{2}$, 3; inches, yard; 11 sec.

100 YARDS VETERANS—L. F. Ralph, 3, 1; L. G. Waterman, 1, 2; no time taken.



FINISH OF 100 YARDS SCRATCH.

100 YARDS SCRATCH (Harold Hirst Cup)—J. Bird (Witton) 1; W. E. G. Rutherford (Express Lift) 2; J. Kimberley (Liverpool) 3; yard, same; 10 4-5 sec.

220 YARDS—R. H. J. Mott 1, H. J. Barron 2, G. F. Luther 3; yard, inches; 25 3-5 sec.

220 YARDS—Final: R. Game, 11, 1; L. T. J. John, 14, 2; J. E. Bigby, 12, 3; inches, yard; 24 1-5 sec.

880 YARDS (A. H. Railing Cup)—C. Willis (Fraser and Chalmers) 1; G. S. Franklin (Witton) 2; S. W. Morce (Express Lift) 3; 6 yds., 4 yds.; 2 min. 11 1-5 sec.

$\frac{3}{4}$-MILE RELAY (Hugo Hirst Cup)—G.E.C., Witton (D. Bawcutt, T. Drake, C. Furness, A. Bird), 1; Head Office, London, 2; 6 yds.; 2 min. 43 sec.

440 YARDS (White Cup)—D. Bawcutt (Witton) 1: C. Furness (Witton) 2; J. B. Kimberley (Liverpool) 3; inches, $\frac{1}{2}$ yd.; 55 2-5 sec.

MILE (Ernest Wilson Cup)—C. J. Willis (Fraser and Chalmers) 1: L. Corshall (Fraser and Chalmers) 2; G. Kilroy (Wembley) 3; 12 yds., 2 yds.; 4 min. 45 sec.

MILE—H. R. Dougherty, 180, 1; E. S. Chisholm, 200, 2; J. H. Bright, 130, 3; 2 yds., 4 yds.; 4 min. 50 sec.

MILE CYCLE—F. Williams 1, C. J. Grant 2, E. J. Tatlock 3; ½ wheel, 2 lengths; 2 min. 27 5-10 sec.

HIGH JUMP (Railing Cup)—C. D. Harker, 5 ft. 3 in., 1; E. F. Price, 2; W. E. G. Rutherford, 3.

MRS. M. J. RAILING DISTRIBUTING THE PRIZES.

The prizes were distributed by Mrs. M. J. Railing following appropriate speeches by Mr. M. J. Railing and Mr. E. Wilson.

The General Electric Company's band from their Lemington Glass Works was in attendance and played throughout the afternoon. After the distribution of prizes the band played for dancing.

Various Items.

"**Some**" **Output**.—To keep up with the growing demand for telephones, the Western Electric Company will manufacture about 480 telephones every hour during 1924, at its factory in Chicago. This estimate is based on schedules calling for a 1924 production of 1,200,000 desk-stand type telephones. From the same source (*Telephone Review*, N.Y.) we note that a million dollars a day is being spent by telephone companies in the United States on telephone construction and replacement.

The Franklin Institute.—The centenary of the incorporation on March 30, 1824, of the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts will be celebrated in Philadelphia on Wednesday, September 17, and two following days, and in view of the high position which this institute holds in the world of science we shall look forward with interest to the commemorative programme which is now being prepared.

Finance.—The balance-sheet of the General Electric Co., Ltd., for the year ending March 31 last shows that, in spite of disappointing returns in the heavy engineering section, the trade of the company still continues to expand, and a dividend of 5 per cent. is to be paid on the ordinary shares after allowing for the full debenture and preference share interest and pension fund and writing off over £184,000 for depreciation. Even then over £212,000 is to be carried forward to next year's account. The annual meeting is to be held on Tuesday next, the 8th inst.

The Institute of Cost and Works Accountants.—The fifth annual dinner of this enterprising institution will be held on Thursday, July 24, at 7 for 7.30 p.m., when the Rt. Hon. the Viscount Leverhulme will take the chair. There will be a Costing Conference on Friday, July 25, the morning session being at 11 a.m., at which Lord Leverhulme will preside. Subject: "Administration and Selling Costs, their Nature and Distribution." Also, an afternoon session at 2.45 p.m. Subject: "The Function of Costing in Industrial Relations." On Saturday, July 26, the members will visit the British Empire Exhibition.

Vacancy Filled.—The vacancy for a power-station superintendent at Stoke-on-Trent, which was advertised in our issue of April 18 last, has now been filled. See an official advt.

Increase of Capital.—The authorised capital stock of the Westinghouse Electric and Mfg. Co. was increased from $125,000,000 par value to $200,000,000 par value at a meeting of the stockholders held June 11 in the main office of the company at East Pittsburgh, Pa., U.S.A.

Exide Service.—On Tuesday, the 24th ult., the various agents and clients of the Chloride Electrical Storage Co. who were able to attend the convention which was held at the London Country Club, Hendon, wound up a most successful convention meeting with a dinner, at which Mr. Dunne presided over a company of about 150 service agents and representatives of the Press. The speeches were much appreciated by all present, and at the conclusion all joined in wishing Mr. Dunne a very happy voyage to the United States, for which country he was leaving in the course of the next few days. Mr. R. H. Jackson, of Manchester, is to be congratulated on the efficient manner in which the convention was organised.

Chester.—A really charming illustrated guide to the dear old city of Chester has reached us from Brookhirst Switchgear, Ltd., of Northgate Electrical Works. It has been written by Mr. Hugh Goody, who is responsible for the Publicity Dept. of that undertaking, and illustrated with various excellent pencil sketches by Mr. W. Mallard. The book really gives a concise history of Chester, and is certain to be appreciated by all who are fortunate enough to receive it. It should, therefore, prove a very efficient way of attracting the attention of overseas engineers and indeed the trade generally to the excellent quality of the goods which are turned out by the Brookhirst Switchgear, Ltd., and at the same time act as a guide whenever they may have the opportunity of visiting this celebrated city. We can cordially recommend it to our readers to whom copies will be sent on proper trade application.

Metrovick Excursion to Wembley.—On Saturday, the 28th ult., nearly 3,000 employees of the Metropolitan-Vickers Electrical Co., from their Trafford Park Works, paid a visit to the British Empire Exhibition. The yellow ribbon badges with the M.-V. monogram in the well-known hexagon were more conspicuous in all parts of the grounds than might have been anticipated, considering the huge attendance on that day, which exceeded 200,000. The excursion from Manchester Central to Marylebone started on Friday night and returned on Saturday night from Wembley Hill Station. An early morning drive round the London sights in motor-'buses was part of the programme, which went through without any serious hitch. The excursionists must have been very tired when they reached their homes on Sunday morning, but they will have garnered memories for future years which are worth garnering at some little personal inconvenience, not the least of these memories being the impressive exhibit of the company which they serve.

Tenders Accepted.—Orders have recently been placed with the G.E. Co. for 32,000 traction lamps for the Victoria Rys. and 5,000 vacuum Osram lamps for the N.S.W. Govt. Rys.——They have also booked orders from the War Office for large supplies of Osram metal filament lamps, both vacuum and gas-filled types, for a period of twelve months, from the L.N.E.R. for a six months' supply of lamps for train lighting, and from the County Borough of Bootle for a nine months' supply of Osram lamps.——The L. and N.E. Rly. Co. (Southern Scottish Area) have accepted the tender of the Siemens and English Electric Lamp Co. for the supply of Siemens standard vacuum, gasfilled and traction type lamps, and also carbon filament lamps, for twelve months.——The Admiralty have accepted the tender of the Edison Swan Electric Co., Ltd., for the supply of switches.——The G.E.C. have secured the contract for the L. and N.E. Railway (North Scottish Area) for twelve months' supplies of Osram metal filament lamps, both vacuum and gas-filled, also Robertson carbon filament lamps.

ARMATURE REPAIRS
MARRYAT & PLACE,
28, HATTON GARDEN,
LONDON, E.C. 1.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
A PRACTICAL TRADE JOURNAL

JULY 11, 1924.

CONTENTS.

	PAGE
Broadcast Receiving Sets	355
The "Magnet" Mine Signalling Key	357
Telegraphy	357
A Souvenir of The British Empire Exhibition	358
An Interesing Exhibit at The British Empire Exhibition	358
Practical Progress in Efficient Power Production	358
Current Topics	361
Some Observations on Stores Routine	362
Questions and Answers by Practical Men	363
The World Power Conference	364
Reviews of Books	364
The G.E.C. Meeting	365
Trade Notes	365
Various Items	366

BROADCAST RECEIVING SETS.*

By Eric E. Barnett.

Mr. Chairman, ladies and gentlemen, in the comparatively limited time at our disposal to-night it is impossible to go with any detail into the multiplicity ot types of broadcast receiving sets which are on the market at the present time. I shall, therefore, give you just an outline of recent developments and an indication of what is to be expected from different types of sets.

Broadcast receiving sets have been largely standardised as to type up to now, but recently some radical departures from previously accepted practice have been made, and I shall give you a résumé of the directions in which developments are taking place at the end of this paper.

Receiving sets specifically designed for listening-in to broadcast programmes usually differ from commercial and experimental receiving sets in two main particulars. Firstly, the wave-length range of broadcast receivers is generally very limited, ranging from about 200 metres to 600 metres, or even less. Secondly, a compromise is usually effected between efficiency and simplicity of control, so that even inexperienced operators may be able to handle the apparatus with ease.

Range of Receiving Sets.

When an average outside aerial is used, consisting, say, of a single wire with a span of 65 ft. at a height ot 30 ft., under normal conditions good headphone signals are to be expected from a station of the power contemplated for Johannesburg if the receiving set fulfils the conditions roughly specified hereunder for different distances.

Up to 15 miles a simple crystal set or a single-valve set will work satisfactorily.

Between 15 and 20 miles a stage of high frequency amplification is desirable, followed by either a crystal or a valve detector.

From 50 to 75 miles one stage of high frequency, a crystal or valve detector and one stage of low frequency will usually work well.

At 100 miles two stages of high frequency are desirable, followed by either a crystal or valve detector and preferably a stage of low frequency.

The foregoing remarks are only intended to be a rough guide, and do not apply to sets using "reflex" or "super-regenerative" circuits. Moreover, the use of reactions has not been taken into account, though by its aid considerably increased ranges are obtainable. The use of reaction will be dealt with later.

If loud and clear signals are received in the headphones, the following additions to the set will usually give satisfactory loud-speaker results under the conditions specified.

For small rooms, one stage of low frequency and a small loud-speaker.

For rooms up to about 15 by 20 ft., two stages of low frequency and a medium-sized loud-speaker.

For large rooms and small halls, a two-stage power amplifier and large loud-speaker.

For large halls and open-air work, a two-stage power amplifier used as a feeder for a number of additional two-stage power amplifiers, each operating a separate large loud-speaker. These separate loud-speakers would be arranged so as to provide an equal distribution of sound over the area to be covered.

Frame Aerial Reception.

With ordinary types of broadcast receiving sets frame aerials are only suitable for use over a range of about 10 miles, and one or two stages of high frequency amplification are usually necessary to give good headphone signals. Low frequency amplifiers as suggested above may be added to give loud-speaker results.

High and Low Frequency Amplification.

The difference between high frequency amplification and low frequency amplification should be clearly understood. High frequency amplification increases considerably the range over which signals can be received, but does not greatly increase the volume of sound delivered by the telephones. Low frequency amplification, on the other hand, adds but little to the range of a set, but greatly increases the volume of sound obtainable. Thus, by the judicious use of high frequency and low frequency amplification, almost any desired combination of range and volume may be obtained.

Tuning Arrangements.

Of the various methods of tuning which can be adopted, the two which appear to be finding greatest favour are: (1) Variometers, and (2) plug-in coils of various types used in conjunction with variable condensers.

Variometers are particularly efficient for broadcast wave-lengths and give good selectivity. On the other hand, plug-in coils provide greater flexibility and are an advantage where loose-coupling is used or where magnetic reaction is introduced. Single-circuit tuning is usually employed for the sake of simplicity, and where great selectivity is not essential it serves admirably.

---

* Paper read before the S.A. Institute of Electrical Engineers.

HIGH FREQUENCY INTER-VALVE COUPLING.

This is usually effected either by an air-core transformer or by "tuned anode" arrangement, and when reaction is employed it is generally introduced into the transformer or anode coil. In some cases the high-frequency transformers are tuned by means of a small condenser, and in other cases semi-aperiodic transformers are used, which are fairly efficient over the whole range of wave-lengths to be covered. Semi-aperiodic transformers are less efficient than the tuned variety, but are more stable in operation and require no tuning controls.

The tuned anode method of high-frequency inter-valve coupling is probably the best for use when only one or two stages of high-frequency amplification are used, but, if further stages of high frequency are employed, this system becomes unwieldy owing to the difficulty of adjustment and the tendency to instability.

When two or more stages of high frequency are used, a potentiometer is generally introduced to increase stability by the application of a slight positive potential to the grids of the high frequency valves. Other methods of providing stable high-frequency amplification will be discussed later.

DETECTORS.

A crystal or a valve is usually used as a detector either alone or in conjunction with high or low frequency amplifiers. Since the efficiency of a good crystal detector is very nearly as high as that of a valve, crystal rectification is often employed where cost is of prime importance. The most serious disadvantage of the crystal detector is that it requires frequent and delicate adjustment, and that this adjustment is often unstable.

The use of a single valve, functioning as a detector, is not to be recommended, as the results obtainable are little better than those given by a crystal receiver unless reaction is used, in which case it is necessary to employ two-circuit tuning in order to comply with the Postmaster-General's regulations, and this is generally not worth while. One valve is best employed (apart from reflex and super-regenerative circuits) in conjunction with a crystal detector.

LOW FREQUENCY INTER-VALVE COUPLING.

This is usually effected by means of iron-core step-up transformers having a turns ratio of 1—4. If these transformers are not of sound design and construction they may be the cause of considerable distortion, and it may not be out of place here to allude to the somewhat controversial statements which have recently appeared in wireless periodicals as to the relative merits of the three methods which may be used for low-frequency inter-valve coupling. The following is a résumé of the chief features and disadvantages of these three methods:—

(1) Resistance capacity coupling is cheap, stable, quiet and very free from distortion. On the other hand, the amplification is comparatively low and very high anode voltages are required.

(2) Choke coil coupling is cheap, moderately stable, fairly quiet and not productive of much distortion, but the amplification obtainable is not very high.

(3) Iron core transformer coupling is not as cheap as the two previous methods; it is moderately stable, and high amplification is obtainable. Unless good transformers are used it is liable to be very noisy and to produce considerable distortion. For all ordinary purposes this method of low-frequency coupling is probably the best, providing that it is well designed.

VALVES.

Some notable developments have recently been made in the manufacture of valves, the chief of these being the reduction of filament current required. Valves of the old standard type consume about .75 amperes at a voltage of from 4 to 6. Then came the "dull emitter," consuming about .3 amperes at 1.8 to 2 volts; next the "peanut," consuming .25 amperes at .8 to 1.1 volts; and still more recently the latest type of low-consumption valve, which consumes only .06 amperes at 2.4 to 3 volts.

These improvements in valves enable an entire receiving set to be run for months off small dry batteries, and eliminate the troubles associated with accumulators. Moreover, with their advent, wireless has become possible for the man in the country who has no battery charging facilities.

DISTORTION.

When broadcasting was first introduced, many people were quite content if they could obtain a considerable volume of mere noise from their receiving sets, but now that some of the wonder of broadcast reception has worn off, listeners are becoming more critical, and manufacturers are accordingly turning their attention to the securing of really faithful reproduction.

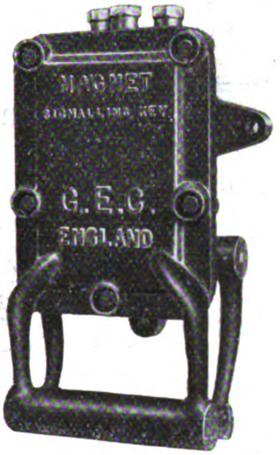
A frequent cause of distortion is the amplifying valve, and, in order to obtain good reproduction, it is essential that correct anode and filament voltages should be maintained. Valves of the ordinary "R" type, and more especially some of the new "dull emitter" valves, have a comparatively low saturation point, and will not handle sufficient current to give great loud-speaker volume without distortion. Moreover, whatever type of valve is used for amplifying, the grid potential must be adjusted so that the valve will function on the straight part of its characteristic curve. A suitable grid bias is usually provided by a few small dry cells connected so as to put a negative potential of 9 volts or so on the grids, or the same result may be obtained by a suitable arrangement of resistances and condensers.

Low frequency inter-valve transformers are another frequent source of distortion, and are apt to prove very noisy if not of reliable make. The quality of reproduction in a low frequency transformer coupled circuit is often improved by shunting the winding of the transformer with a resistance of about 100,000 ohms, thus flattening out the resonance curve and producing more even amplification over the whole range of voice frequencies.

Loud-speakers are often unjustly blamed for causing distortion, which really originates in the components or circuits with which they are associated. A good loud-speaker, if properly connected and handled, is capable of giving very fine results, and, when distortion occurs in such a loud-speaker, it is almost invariably because it is being overloaded. A medium-sized loud-speaker will give as much volume as a good gramophone without distortion, but it must not be expected to give faithful reproduction with a volume rivalling that of a brass band.

(To be continued.)

THE "MAGNET" MINE SIGNALLING KEY.



A new pattern of mine signalling key has recently been introduced by the General Electric Co. under the name "Magnet," and they claim that it marks a decided advance upon the previous patterns, having been specially designed to comply in all respects with the present-day requirements of H.M. Home Office respecting safeguards.

The electrical mechanism is contained in a substantial cast-iron case with malleable iron cover, as shown in our illustration, and consists of a spindle carrying a forked flat spring. This is kept in the closed position with the upper contact ready for receiving incoming signals by the pressure of two spiral springs, and outgoing signals are given by a grip lever which rotates the spindle and causes the flat spring to close with the lower contact.

The grip lever is entirely protected by a robust guard of malleable iron and is therefore not only protected against breakage by a fall of debris or accidental blows but accidental signals due to men carelessly leaning against the key, or throwing stones, are rendered impossible. It has a further advantage over the knob pattern in that it is far easier to manipulate and much less fatiguing to the operator. Moreover, quicker signalling can be carried out

Leaflet 76/2-1, which has just been issued by the **Metropolitan Vickers Electrical Co., Ltd.**, deals with their tubular pattern Resistance Units and Unit Resistances, for which there is a wide field of application in the construction of motor starters, field rheostats, instrument resistances and many other purposes. Illustrations are given of the various types and sizes, together with clear technical details, which should interest all who have to make use of such apparatus.

Catalogue W.L. 5, which has recently been issued by **Henley's Telegraph Works Co., Ltd** (Eng. Dept.), of Blomfield Street, London Wall, London, E.C.2, gives full particulars of a new range of 30/60 amp. Ironclad Service Cut-outs, in which are several new features making for increased efficiency and simplicity. They are the patent slam catch, obviating the use of sealing pins liable to get misplaced, the phosphor bronze spring fork for securing the circuit terminal, thus disposing of the possibility of leakage to the cast iron case due to the compound coming away and leaving an exposed screw-head securing the terminal in the base, and the large cup washer fitted under the fuse wire clamping screw which prevents damage to the wire when tightening up and facilitates re-wiring. Other interesting features of the new range are the minimum number of standard parts employed and their interchangeability. Tests made by the National Physical Laboratory are given on pages 4 and 5, and afford ample proof of the reliability which Messrs. Henley claim for them.

TELEGRAPHY.*

Being solutions to the questions set at the Grade I. examination in Telegraphy held by the City and Guilds of London Institute, on April 30, 1924.

(Continued from page 312.)

Q.—What are earth currents? What methods would you adopt to restore communication over a route on which earth currents prevented ordinary working?

A.—From causes either unknown or imperfectly understood, different parts of the earth are at times at different potentials. If an electrical circuit includes two points which are at different potentials, a current will flow from one point to the other in the effort to restore electrical equilibrium. Such currents are termed "earth" currents, and on occasions they are of such magnitude as to render working by ordinary methods impracticable. Earth currents are frequently in evidence when there are "magnetic" storms, *i.e.*, when the magnetic declination and the horizontal and vertical forces show considerable and irregular variations. They also occur when the aurora show frequent and abrupt changes.

Two methods are adopted to prevent earth disturbances:—

(1) A metallic return is used instead of an earth return.

(2) Condensers of large capacity are inserted in the line circuit.

Method (1) is a complete remedy, but if spare wires are not available it reduces the number of working circuits by half. Metallic working is arranged between two offices worked from separate batteries by disconnecting the earths at both offices and connecting the line in place of them (Fig. 3).

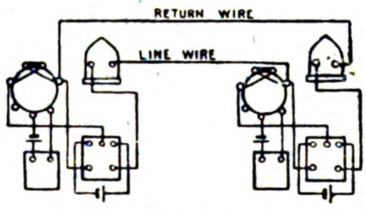


FIG. 3.

Method (2) is illustrated in Fig. 4, which shows a double current circuit with a condenser of 10 microfarads capacity inserted in the receiving circuit. As the circuit is worked by condenser impulses the tongues of the relays must be set neutral and be finely adjusted.

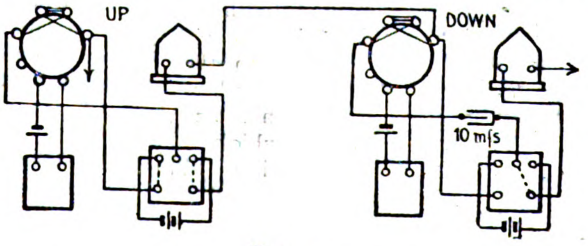


FIG. 4.

(To be continued.)

---

* Books recommended are:—*Questions and Solutions in Telegraphy and Telephony, Grade I.*, by Few (Rentell, 5s. 10d., post free), and *The Telegraphists' Guide*, by Bell and Wilson (Rentell, 3s. 10d., post free).

A SOUVENIR OF THE BRITISH EMPIRE EXHIBITION.

No better souvenir of Wembley can be imagined than the miniature reproductions of the ornamental spheres used for illuminating the grounds, which have been produced by the General Electric Co., Ltd. Some 500 of the full-sized lighting units were manufactured by them to the design of the architects to the Exhibition, Sir John W. Simpson, F.R.I.B.A., and Maxwell Ayrton, Esq., F.R.I.B.A., who have kindly consented to the reproduction of their registered design in the form of a particularly novel and handsome table standard.

Supplied in gilt finish, complete with globe, lampholder, flexible cord and adaptor, these standards, which we illustrate, are already proving extremely popular with visitors, and, unlike many souvenirs, they are of utilitarian as well as decorative value. When equipped with a suitable Osram Colour Sprayed gasfilled lamp, the sphere has the appearance of a ball of softly glowing light, the colour of which can be made to harmonise with the surroundings with very pleasing effect.

AN INTERESTING EXHIBIT AT THE BRITISH EMPIRE EXHIBITION.

The Palace of Engineering at the British Empire Exhibition is visited chiefly by engineers whose sole desire is to see the latest improvements in engineering, both electrical and mechanical, from the prime movers to direct or converted methods of applying energy. Before, however, one can accurately determine the extent of improvements made in any branch of engineering, it is necessary to make comparisons between these improvements and methods which preceded them. There is no doubt that considerable progress has been made in the efficiency of electric lamps, but in order to realise the extent of these improvements it is advisable to make comparisons between the modern gasfilled lamp and those which were in use, say, forty years ago.

Visitors to the British Empire Exhibition who are interested in electric lighting have an exceptional opportunity of making these comparisons, since an exhibit of an extraordinary nature is on view at the stand of Messrs. S. Rentell and Co., Ltd., in Bay 14, Avenue 15, in the Palace of Engineering.

The exhibit is contained in a circular glass case, and consists of a number of electric lamps as follows:—

1.—One original Swan lamp.
2.—One original Edison lamp. Both these lamps were in use in the Crystal Palace Electrical Exhibition in 1882.
3.—One original Swan United lamp.
4.—One Khotinsky Lamp.
5.—One Khotinsky lamp, but with pink stripes in the bulb.

This last lamp is evidently an attempt to introduce colour in lighting. When one glances at this lamp and then remembers the extensive use of colour in illuminating the grounds of the Exhibition, the enormous strides made in the use of colour in lighting can be realised.

Another item of the exhibit is an old fuse carrier. This is made of wood, contact with the fuse wire being made through the medium of wood screws. Comparisons between this and the modern fuse carrier which has to meet Home Office requirements will at once indicate the extensive progress made in this direction.

A Woodhouse and Rawson lamp of about 1887 has since been added to the exhibit.

PRACTICAL PROGRESS IN EFFICIENT POWER PRODUCTION.

Last week a correspondent, in describing the "Chloronome" process for keeping condenser tubes free of fouling matter, mentioned incidentally the many comparatively recent developments on the steam side of generating plants towards economy. He instanced the increase in boiler sizes, in the steam pressure used (North Tees Power Station runs at about double what has been normal, and experimental steps are being taken elsewhere towards much higher pressures), air heating, pulverised fuel, etc. The "Chloronome" process itself is an example, for it means more efficient operation of the condenser, and hence a direct bearing on plant efficiency. Mr. George Raw, in his presidential address to the Association of Mining Electrical Engineers, has pointed out the factors affecting combined steam and electrical plant at collieries. Coal being immediately available in such cases, steam-operated machinery became common and inevitable. Then came, generally from external sources, the supply of electricity, which colliery engineers accepted either in lieu of existing plant power or as supplementary. Some collieries laid down their own power stations, most of which now "float" on the local supply system, with advantages mutual to the parties concerned. Mr. Raw, while admitting the idealist claims of total electrification for mines, did not think that mining engineering had yet reached a stage where steam could be dispensed with. One may point out, nevertheless, that many collieries persist in using steam plant which is very uneconomical, the fact that coal is so cheap and handy being the reason. On the other hand, there is the case of a colliery similar to that recently visited by the writer; here the winder was worked by steam. The plant was modern, however, and the writer, urging the claims of electrical winding and control, was told that the plant would last out the mine—"hundreds of years," though!

Patent Litigation Settlement.—An agreement has been reached between the Northern Electric Co., of Montreal, Canada, and Siemens Bros. and Co., of London, England, under the terms of which the Siemens Company acknowledges the validity of the patents of the Northern Electric Co., Ltd., and the International Western Electric Co., Inc., in Canada, relating to automatic telephone exchange equipment, and accepts a licence thereunder. The Siemens Company further licenses the Northern Electric Co., Ltd., and International Western Electric Co., Inc., under its patents in Canada relating to automatic telephone exchange equipment.

Poverty may mean inspiration to the young but desperation to the old.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N. 17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application, Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

"Power" or "Energy."

During the current week Wembley has been the venue of the world's so-called "Power" Conference: a gathering of experts and engineers from all over the globe to discuss the present and future power resources of the Empire with a view to their conservation and future development and application to the needs of mankind. Cheap power means increased production, less unemployment and a higher standard of living in all the countries concerned. Is it not, however, a misuse, or, rather, loose application, of the word? "Power" is generally understood among engineers as the "rate of doing work," whilst "energy," whether latent or kinetic, steam, hydraulic or electrical, is more correctly the factor which is the basic subject of discussion at this conference. Nor is this the only example of misuse of the term "power." One of the principal exhibitors in the Palace of Engineering has recently staged a large sign setting forth the capabilities of its exhibit of a turbo-alternator, viz., that this machine supplies sufficient "Electrical Power" for a community of 125,000 persons. We pose as engineers; let us at least be correct in our phraseology.

Credit Where it is Due.

Whilst congratulating Senator Marconi upon his recent achievements in short-wave low-power directional wireless telegraphy over long distances, I would like to refer once again to the invaluable experimental work in long-distance short-wave trans-Atlantic telephony carried out by an enthusiastic band of amateurs some time ago. Following on their success in telephoning across the Atlantic with comparatively negligible energy of transmission, I commented on the possibility of applying the same principle to long-distance wireless telegraphy and the apparent lack of necessity for the projected powerful transmitting stations and costly gear then considered essential by the Marconi Company. If I remember rightly, the reply was to the effect that those amateur results were freak results, only possible during certain seasons and times of darkness, and that the only certain method of commercial communication with America and other distant points by wireless at any time of the day or night was by high-power and the use of long wavelengths.

Senator Marconi's latest announcement before the Royal Society of Arts rather contradicts this claim and would appear to indicate that those early experiments by amateurs in short-wave wireless telephony have borne due fruit by opening up a new line of experiment for the professional companies. If this is so, I feel confident that Senator Marconi will be prepared to give due credit to the small band of enthusiasts who, with no axe to grind, and at their own expense, proved once and for all that excessive energy was not essential to the bridging of oceans by wireless communication. The new system opens up great possibilities in the way of considerably cheapened and accelerated service coupled with an appreciable measure of secrecy, parabolic reflectors being employed to project the energy in the desired direction and restrict it to a narrow beam.

Women and the Telephone.

According to the Japanese Department of Communications women waste more time than men in idle talk over the telephone, and as a result the Department is advocating the abbreviation of the period of a controlled call. Probably what is true of the Japanese ladies applies in a more or less direct sense to British women; at all events, I saw a lady only the other day in a telephone call-box who had taken off her hat and hung it up on a convenient projection, thus making herself comfortable for what promised to be a prolonged gossip with a friend about things in general. Many a time and oft have I inwardly fumed whilst waiting to deliver an urgent message from a public telephone call-box what time some lady fair was discussing fashions and the like with her correspondent at the other end of the line. On one occasion I timed the offender; she was in that silence cabinet exactly nineteen minutes and a half enjoying what purported to be a three-minute call. When Tokyo gets its Strowger Automatic Telephones the authorities look like having to introduce a time element feature between the dial and the exchange to limit the "hold-up period."

Safe Electric Light.

Apropos public health and the recent disclosures anent the probable causation of cancer, it behoves us to take every precaution against ill-health or insanitary conditions of living, and in this connection it is noteworthy that many doctors think that slight gas leakages in bedrooms and living rooms are the cause of a great deal of ill-health, such as headache, giddiness, anaemia, etc. Dr. E. B. Hazleton, of Sheffield, has reported that he has found leakages from most of the gas taps examined, and that in ill-ventilated bedrooms it was common to find in the morning as much as 0.02 per cent. of carbon monoxide in the air of the room. "One has no difficulty in believing (says the *Lancet*) that if a person breathes night after night an atmosphere containing 0.02 per cent. of carbon monoxide the effects on his health may be quite serious." Now that this deadly gas forms a considerable percentage in admixture with most domestic gas supplies, it behoves the householder to make doubly sure and often that his gas taps are well fitting. A system of frequent inspection by the gas suppliers would probably prove the best safeguard against this danger, whilst a conversion to electric lighting makes doubly sure and eliminates all risk.

The Institute of Metals.

Among the forthcoming events of this memorable exhibition season is the annual autumn meeting of the Institute of Metals, which will take place in London from Monday to Thursday, September 8-11 inclusive. The annual autumn lecture will this year be delivered by Mr. W. M. Corse, S.B., of the National Research Council, Washington, D.C., U.S.A., a distinguished American metallurgist. Several other papers of close interest will be read and discussed, and an opportunity will be afforded members attending this meeting to visit Wembley Exhibition. In connection with the proceedings, and to add to the welcome extended to overseas visitors, a reception will be held at the National Physical Laboratory, Teddington, by kind invitation of the Director.

Verbum Sap.

All who are interested in Empire development and the promotion of overseas trade with our Colonies and Dominions should read, mark, learn and inwardly digest the report of Mr. P. J. Pybus, C.B.E., managing director of the English Electric Co., who has just returned from his third business visit to Canada since the war. Thus Mr. Pybus: "An early impression one gets there is of the vast network of overhead lines carrying cheap energy to factory and home. Canada has so thoroughly developed her water-power resources that she is almost an electrified country, but the resources already exploited are but a small part of her potential capacity. These resources, combined with the spirit of the country, ensure the fact that industrially Canada has a great future. But she needs people."

"The Dominion is largely an agricultural country, and farm workers are wanted, but her need for really skilled workmen must not be overlooked, and as Canada's industry extends so will that need grow. Which brings me to the point that for the extension of commerce more capital is required. That is the direction in which Britain can do much, and in doing it bind the two countries more closely together. During my three visits to the Dominion since the war I have been more and more impressed by the almost passionate desire to draw more closely to the mother country. Politicians of all shades of opinion would be well advised, while standing firm on their political faith, frankly to recognise this significant feeling."

ELEKTRON.

Quotations Wanted.—The Municipal Council of Johannesburg invite tenders for the supply of switchgear panels.——The Electricity Dept., City of Cape Town, invite tenders for cables. Specifications, etc., from the D.O.T. (Room 52), 35, Old Queen Street, London, S.W.1.

SOME OBSERVATIONS ON STORES ROUTINE.

By W. J. Hiscox.

It is necessary, in the interests of efficiency, that supplies from the factory stores should be obtainable only upon receipt of an official requisition, duly signed by a responsible official, and this is often regarded with disfavour by the operator, particularly in the factory where systemised routine is still in its infancy. The operator requires, say, a dozen bolts and nuts, and instead of proceeding to the store and getting these for the asking (with an extra one or two thrown in), he is compelled to get a requisition from his foreman and then present this at the stores counter. Even then he is not sure of getting the goods, for the requisition may contain incorrect or insufficient information, and until the matter is put right his demands cannot be met.

He feels aggrieved at all this pomp and circumstance over such a small matter, and blames the system for the trouble he is put to. In this, however, he takes the wrong view, for although the system decrees that no requisition shall be accepted until the information contained thereon is accurate, it is due to somebody's blunder that inaccuracies occur and delays follow. The procedure is designed to facilitate production, and it will do so if properly handled; but if it is mishandled, then obviously it will have an adverse effect, so far as the immediate requirement is concerned. The operator is naturally concerned with his immediate needs, and if these are not catered for promptly he sees only the effect, without troubling about the cause. That the system is devised to assist him he does not realise, for whilst it is being carried out efficiently the nature of this assistance is not apparent to him. How often does he say to the storeman, "You are retarding production," because the latter turns back an inaccurate requisition or refuses to give one or two pieces over the authorised quantity? "The time spent in writing out the requisition is of more value than the articles covered," he will say; and in many cases this undoubtedly is so. Yet, what a state the store would be in were no attention paid to routine—if goods were simply handed out upon verbal demand, and no record made of the issue! The operator would be satisfied, so long as supplies lasted, but when supplies run out he will speedily blame those who have miscalculated owing to the absence of sufficient data relating to the state of the stocks.

If the requisition contains inaccurate information it is usually the fault of either the operator or the foreman, and unless these people are taught to appreciate the meaning of routine, there will be frequent delays in obtaining supplies. Although the requisition is made out by the foreman, it is usually compiled from information furnished by the operator, and if this information is incorrect the operator has only himself to blame if he is put to trouble and inconvenience before his requirements are met.

Figures are a bugbear to many operators, but they are essential, and the management must contrive to make the business as simple as possible. If each job is covered by an order number and each detail by a part number, it is upon these numbers that the success of the transaction depends. They must be clearly defined and their importance emphasised. The operators should be encouraged to talk in numbers rather than in terms, for whilst the number is definitely identified with a specific part, the term may be made to fit two or three parts.

The operators should be taught the elementary principles of costing, so that they may grasp the significance of the order number, and what accurate stores records stand for, so that the importance of the part number may be appreciated. Unless the operators are acquainted with the reason, they are not likely to grasp the importance of the proceeding, and, accepting the requisition as a necessity, they will make use of this without troubling about its accuracy. They must be taught that the order number represents the job, and that all supplies requisitioned on an order number are charged to the corresponding job.

The foreman, too, must handle requisitions in a systematic manner, for it is due to his haphazard methods that so many errors occur. He is prone to rely too much upon the information given by the operator, and although it is perhaps impossible for him to challenge in every instance the accuracy of the order number or the part number given, he can at least check the information given from time to time, whilst, again, he can call to account the operator responsible for the information appearing on a requisition rejected by the store on account of inaccuracies.

Sometimes, however, the store assistants are at fault in the matter of delays at the counter, these being occasioned by a shortage of supplies, brought about by inaccurate records. The stores records are of the utmost importance, for much is dependent upon them, and accuracy is therefore imperative. The card (or book) record should show precisely what is in stock, so that it is known when the necessity arises for further supplies to be ordered. For instance, the record may show one hundred pieces to a certain part number in stock, and as orders for further supplies are not placed until the quantity is down to fifty, the order clerk assumes that, as one hundred pieces are recorded as being in stock, there is sufficient to satisfy present requirements.

Unknown to the order clerk, however, one of the store assistants is in the habit of giving one or two pieces over the quantity requisitioned in each instance; but as the stock record is compiled not from the quantity issued, but from the quantity requisitioned, it follows that there is a discrepancy between the recorded and the actual stocks. From this it will be seen that, as time goes on, the discrepancy becomes greater, until at last the actual stocks are exhausted, although the record shows, say, fifty pieces in stock.

It is at this time that an order is placed on the purchasing department for further supplies, the order clerk assuming there are still fifty pieces in stock; but when the next requisition is received from the shops it cannot be met. Some days must elapse before the new supplies are received, and this means delay in regard to production. The store assistant should never allow the operator to beguile him into giving "one or two over," for if he does he will be "left" in the end. The exact number should be given in each case, and if subsequently some are either scrapped or lost, a requisition to cover replacements should be demanded, this bearing a reject number or other indication that the parts are extra to the allotted quantity for the job.

It is well to accelerate production wherever possible, but it is not accelerated when the action satisfies the immediate need at the expense of the future, by cloaking an error or by shielding a delinquent. The storeman is not thanked by the operator when his misguided action causes a failure of supplies, and it is better to be groused at for doing one's duty than to be cursed at on account of unfortunate results arising from doing a good turn.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 184.

I would appreciate details of a three-phase 6,600-volt transmission system (overhead). What is the function of the guard wire? What type of earth plates are used? Is every lattice-type pole earthed, etc.?—"FREQUENCY."

QUESTION NO. 185.

I understand that every central station has a potentiometer for calibrating instruments. What are the advantages of this instrument for this purpose as compared with standard instruments?—"JUNIOR-SHIFT."

(*Replies to Questions Nos.* 184 *and* 185 *must be received not later than July* 26, 1924.)

Obituary.—We regret to record the death, which took place on Thursday (26th ult.), of Mr. W. H. Hitchcock, of Siemens and English Electric Lamp Co., Ltd., 38-39, Upper Thames Street, E.C.4. He had been associated with Messrs. Siemens for some 25 years, and, since 1919, had been manager of their branch at Newcastle-on-Tyne. Needless to say, he is sadly missed by all his colleagues.

A Visit to Wembley.—Between 50 and 60 members of the Diesel Engine Users' Assocn. and their friends visited the British Empire Exhibition on June 27th. Arrangements had been made so that the party might lunch together at one of the restaurants. After lunch the party split up into small groups, and the exhibits of various firms in the Palace of Engineering of special interest to users of heavy-oil engines were visited.

Electricity Supply in War Time.—A very interesting paper on "Electricity Supply in War Time as Affected by the Improvement in Heavy Oil Engines," which was read before a meeting of the Diesel Engine Users' Assocn. on May 9th last by Messrs. A. H. Dykes and W. T. Townend, has been reprinted as a pamphlet, together with a report of the discussion which followed the reading of the paper and the author's reply thereto. It is a valuable contribution to a subject which is of real importance to the country at the present time, and should interest all central station engineers. The price of the reprint is 7s. per copy.

THE WORLD POWER CONFERENCE.

We are very pleased to note the general interest which has been displayed in this, the first conference of its kind. Articles dealing with it from many different points of view have appeared in most of the leading dailies, quite apart from the space which is being devoted to it in the technical journals, and we can but hope that the ultimate results will more than reward Mr. Dunlop and those who are associated with him in the tremendous programme of papers and discussions which is now running its course at the British Empire Exhibition. The official opening ceremony on June 30 by H.R.H. the Prince of Wales gave it a right good start, and the speeches at the Queen's Hall in the evening, when the Earl of Derby presided at the dinner, struck a most enthusiastic note. The 750 guests represented most, if not all, the thirty-nine nations participating in the conference, and this cosmopolitan character was marked by a display of national flags, which greatly brightened the hall. In the course of his speech proposing success to the "First World Power Conference," the chairman prophesied that from it would come a fund of knowledge which would advance electrical science to a great extent, and this was being contributed for the common good. Undoubtedly the decisions reached would have a far-reaching effect, and no industry would be able to treat them with indifference because they would have an important bearing on the cheapening of production. Replies were given by M. Arbelot (France), Mr. F. V. Hansen (Sweden) and Mr. Samuel Insull (United States), the latter, who was born in London, ending a charming speech with the remark that he felt it a great privilege of responding for the country of his adoption in the country and city of his birth. Dr. Ferranti proposed "Our Guests," and replies were given by Mr. Frank Hodges, M.P., Mr. J. G. Bellaar Spruijt (Netherlands) and Col. the Hon. Sir James Allen, K.C.B. (New Zealand), after which Mr. A. M. Grier, K.C. (Canada), proposed the health of the chairman in a virile and intensely patriotic speech, which was received with hearty enthusiasm. In his reply the Earl of Derby expressed his delight at the good which was bound to come from the friendly intercourse between the nations represented, and then went on again to say how much was due to Mr. Longbottom and Messrs. Dunlop, Rodgers and Weekes for their organisation of the conference. No doubt the opening functions were most auspicious, and we can all hope that in the long run the trade and commerce of the British Empire will have reason to be thankful for the forethought of those who are in any way assisting in promoting the success of the conference as a whole.

Finance. The balance-sheet of Crompton and Co., Ltd., for the year ending March 31st, 1924, only shows a profit of just over £2,800, and, in order to cover the dividend on the preference shares, the directors have transferred the sum of £8,500 from the reserve account, leaving a balance of nearly £1,500 to be carried forward.

Finland.—The report on the industrial conditions in Finland has just recently been issued by the D.O.T., and may be obtained from H.M.S. Office or *Electricity* office price 2s. 1d. post free. Apparently trade in that country has been somewhat erratic during the past few months, but it looks as if it is now on the up grade. We note that there is a scheme on foot to form a private company to erect and work a broadcasting station at Helsingfors.

Reviews of Books, &c.

[*Books noticed in this column will be sent from* ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.*]

THE MOON ELEMENT. By E. E. Fournier D'Albe, D.Sc. (Fisher Unwin, 10s. 6d. net.)—Quite a number of the readers of ELECTRICITY have at various times written to us asking for details about selenium and selenium cells, and it is therefore a great pleasure to us to receive this book and to be able to recommend it to them as one which should give them a very large amount of the information they seek. It is really the first connected account of the properties and applications of an element which promises to have a paramount influence upon wireless and other new developments of the present century, and the author has gone to great care in presenting the fullest possible information in regard to selenium which he has been able to obtain from all the sources at his disposal. The illustrations are good, and the details regarding the optophone for enabling the blind to read are really most fascinating. In conclusion there is a chapter describing the possibility of conveying speech along a beam of light, together with illustrations of the acetylene photophone, as well as an appendix on the use of selenium in star transits, and altogether we have no hesitation in recommending the book as of direct interest to a wide circle of scientific readers.

COLLIERY ELECTRICAL ENGINEERING. By G. M. Harvey, A.M.I.E.E. Demy 8vo, cloth, 387 pp., 153 illustrations. (Pitman, 15s. net.)—Coal is of such direct importance to the whole commercial prosperity of this country, and so much depends on the price at which it can be raised and distributed in order that it may meet its competitors in the markets of the world, that the mine-owners, managers and colliery engineers, for whom this book has been written, are fairly certain to give it a cordial welcome if only for the fact that it represents the very latest practice, and should, therefore, act as a reliable guide or indicator towards the goal of reduction in cost per ton. It is a pleasure to note the author's remark in the preface that the collier no longer sees in the electric coal-cutter a device for "doing him out of his job," and it is a thousand pities that this knowledge in its widest sense is not shared by men in other industries who wilfully ignore the cold logic of facts, and will not see that to cheapen the cost of production of an article, whether it be a ton of coal or a brick-built house, is bound in the long run to increase the demand for the commodity, and thereby involve the employment of yet more colliers or bricklayers. Mr. Harvey takes the reader most methodically through all the electrical work connected with a modern colliery, or alternatively an old colliery which it is desired to modernise, from the initial demand for current and how it shall be obtained, right away to the practical administration of the plant when in use, so as to comply with all the regulations made by the Home Office for the protection of the mine employees. For instance, at the start he discusses the alternatives of taking current from a power supply company if available, or erecting a private plant, and then goes on to explain conditions under which existing plant should be absorbed or scrapped. Different types of power stations are described and illustrated, as well as the machines, switchgear and distributing systems suitable according to the varying conditions. Other chapters deal exhaustively with the underground plant, haulage systems, coal-cutters. shaft signalling systems, telephones, batteries, and the numerous miners' lamps now on the market. Altogether it is a book which it has been a delight to read, and in our honest opinion it is about the best on this subject which has yet made its appearance. We can recommend it without hesitation to our numerous readers who are associated with this class of work.

ALTERNATING CURRENTS. By A. E. Clayton. 296 pp., 253 figs. (Longmans, 10s. 6d. net.)—This book may confidently be recommended as an introduction to the study of alternating currents suitable for the use of second-year students. Its aim is to give the student a sound knowledge on matters of fundamental importance, and attention is therefore devoted to basic principles rather than to descriptions of apparatus. The characteristics of different alternating current circuits are dealt with thoroughly, and so also are the fundamental characteristics of the polyphase alternator, the transformer and the polyphase induction motor. The development of locus diagrams for typical circuits is explained very satisfactorily, and a feature which will be much appreciated is the chapter dealing with the symbolic method of calculating A.C. problems. The advantages of symbolic notation for more advanced work are so great that it is difficult to understand why the method is not used more extensively in this country. The author's careful treatment of the subject deserves the highest praise, and the reader will benefit greatly from the large number of specially selected examples appended to each chapter. These examples have been chosen for their educational value, and answers are given in each case. From a hint in the preface we learn that the author has in preparation a more advanced and comprehensive treatise on alternating currents, and we await with interest the appearance of this more ambitious work.

THE G.E.C. MEETING.

We referred in our last issue to the fact that the directors of the G.E. Co. are paying a dividend of 5 per cent. on the ordinary shares for the year ended March 31, 1924. At the meeting which was held on the 8th inst., Mr. Hirst gave to the shareholders one of his usual inspiring addresses, in which he dealt clearly and straightforwardly with the position of the company, the past year's trade and the future outlook, and explained that the orders in hand represented a very large amount of new business, including the construction of various turbo-generators ranging from 15,000 to 25,000 kilowatts for the Corporations of Birmingham, Marylebone, Sydney, Adelaide and Brisbane. Other orders on the books are contracts for the equipment of 46 motor coaches for the London Underground Railway, motors for various tramway undertakings, rolling mill motors up to 20,000 h.p., and some of the largest material handling plant ever built, for Barking and Beckton. The business in cables and wires has grown to such an extent as to lift them into the front rank of cable makers of Great Britain, and the company are members of the Cable Makers' Association, which is in itself an admission of the quality of their goods. They have also perfected a system of their own for the use of powdered fuel, and a number of orders are in course of execution. This latter is one of the points on which various articles have appeared in the columns of the technical Press during the past few months, and there is no doubt that the directors of the G.E. Co. are acting wisely in giving it their most careful attention. The work in the telephone section of the company's organisation is remarkably brisk, and altogether we shall look forward with keen interest to a still brighter report at the end of the year which is now passing. Finally, we do most cordially endorse Mr. Hirst's complaint about the removal of the McKenna duties. With him, we think it was a great mistake.

Trade Notes.

Messrs. Henley have issued a well-printed sheet, varnished and mounted on rollers, for hanging in a conspicuous position where users of Henley Plywood Backboards are likely to see the picture and remember that they will most probably require supplies thereof in the regular course of their installation work. Not only does the sheet give details of the erection material contained in each millboard case, but each side has useful columns of metrical equivalents which are likely to be of value when figuring out calculations in which the metrical system is used. Factors and dealers can obtain this sheet on proper trade application.

Siemens Bros. and Co., Ltd., of Woolwich, have issued Catalogue 805, which gives illustrations and details of their Water Pyrometer. Although this instrument has been on the market now for a great number of years, it still stands unrivalled in its own particular field, largely on account of its simplicity, strength and low cost. It is suitable for measuring temperatures up to 1,200 deg. C. (2,200 deg. F.), and Messrs. Siemens claim for it various important advantages, not the least of which is that the calibration of the scales is based upon a series of tests carried out by the National Physical Laboratory.

Booklet No. 706C which has been issued by **Messrs. Bruce, Peebles and Co., Ltd.**, engineers, of Edinburgh, is a well-illustrated catalogue of 48 quarto pages. It describes the works and manufactures of this well-known electrical engineering firm, and is divided into three parts dealing respectively with the actual works in which the construction is carried out, the plant and machinery which are made, and the installations in which the said goods are doing good service in all parts of the globe. It should, therefore, be of direct value to all installation contractors and engineers in charge of electric lighting and power machinery.

Leaflet No. 145, dealing with the Peebles-Reyrolle Automatic Sub-Station Plant, has just been issued by **Messrs. Bruce Peebles and Co., Ltd.**, of Edinburgh, and should appeal to central station engineers and installation contractors generally. It gives illustrations of the plant referred to, which has just recently been designed for automatic self-starting and stopping for traction and general lighting and power supply, and it is claimed that it ensures a definite sequence of operation with greater precision than is possible by manual operation.

Two new pamphlets issued by the **G.E. Co., Ltd.**, are Technical Description No. 220 and leaflet X 3,101. The former deals with G.E.C. Ironclad Switchboards of the Unit system, with "Salford" Switches and Switch Fuses, and shows illustrations of boards which have been constructed for such varied purposes as theatre lighting, colliery work, etc., while the latter gives detailed specifications of the switchboards built to the Unit type, together with the prices according to the work for which they are constructed. Both lists will therefore appeal to all central station engineers, installation contractors and engineers in charge of heavy lighting and power plant.

A very fine set of change-over oil immersed draw out switchgear was recently designed and manufactured by the **General Electric Co., Ltd.**, to the order of Messrs. The Imperial Tobacco Co. (of Great Britain and Ireland), Ltd., in connection with their Ogden Branch, Boundary Lane, Liverpool, and should appeal particularly to engineers desiring to install this class of gear in connection with schemes dependent upon two separate sources of supply. Full details and illustrations will be willingly furnished to installation contractors and engineers on application.

An excellent 32-pp. catalogue of Benjamin reflector fittings and lighting specialities has been issued by the **Siemens and English Electric Lamp Co.** It is numbered 70 in the company's list of catalogues, and contains a large number of illustrations showing the various patterns of Benjamin reflectors, which can be obtained from the company's depot in Upper Thames Street, and should, therefore, be of interest to every electrical installation contractor.

The electrical heating of water for domestic purposes is usually regarded as an uneconomical proposition, due to the comparatively high price of the unit in this country. With the Combination K.N. Electric Water Heater and Towel Rail, however, hot water is immediately available at any time of the day or night with a consumption of energy limited to the immediate needs and with no appreciable loss. The K.N. Electric Water Heater comprises two rails or tubes with enclosed immersion elements, and through which the water passes when the tap is turned on. Turning on the tap also switches on the current, and, when the water is cut off, the flow of electricity also ceases. There is thus no waste, and the temperature of the issuing water can be regulated to a nicety. The loading of each nickel-plated rail is 2 K.W. or 4 K.W. total for each heater, and the normal flow of water is 20 gallons per hour. Fixing the heater in any bathroom or other apartment involves no structural alterations, and it has an ornamental appearance. It is marketed by the sole manufacturers, **Messrs. Moseley Installations, Ltd.**, Birmingham, who will furnish full particulars on request. It is equally applicable to A.C. and D.C. Circuits, but voltage should be stated when ordering.

Leaflet 200/5-1, from the **Brush Electrical Engineering Co., Ltd.**, of Falcon Works, Loughborough, illustrates and describes a new high tension oil-immersed tapping switch for transformers, which should prove of interest to all central station engineers and engineers in charge of transformer plants.

Premium Awards.—The Council of the I.E.E. have awarded premiums, value £10 each, to the following students for papers read during the session 1923-24: Mr. N. B. Hill (Cape Town), Mr. A. I. MacNaughton, B.Sc. (Eng.) (Airdrie), Mr. V. Mitchell (Settle, Yorks), Messrs. O. Morduch (Manchester) and A. W. Metcalf (Manchester), Mr. B. Nuttall (Manchester), and Mr. A. C. Warren (London).

Important New Book.—A new book which will appeal to all central station engineers and men in charge of steam boilers has just been issued by Messrs. Chapman and Hall. The title is "Coal and Oil Fired Boilers," by Drover, and the price is 16s. 6d. net, post free, from ELECTRICITY office. It is a work of some 350 pp. with 191 illustrations, and should appeal to quite a large number of our readers in view of the keen interest which is now being taken in the production of steam at the very lowest possible cost consistent with high efficiency. A review of the book will appear in these columns in due course.

Various Items.

Tenders Accepted.—The G.E.C. have secured the contract for the Borough of Holborn for a nine months' supply of Osram metal filament high wattage lamps for street lighting.

Bastian Patents.—The U.S.A. patent covering the Bastian Storage Geyser was issued on May 13, 1924. No. 1,494,207. The Bastian Quartzalite Glower was the pioneer of red-hot heating elements both in this country and in America, and it is claimed that the Bastian Patent Storage Geyser has already established itself in the home market as the first practical solution of the electric water heating problem. We congratulate Messrs. Bastian and Allen on the prospect thus opened out of doing first-class business in the American market.

A Market for Wireless Apparatus.—Confidential reports on the market for wireless apparatus in the Dominican Republic and Hayti have been prepared by the Department of Overseas Trade from information received from the Department's representatives at Santo Domingo and Port-au-Prince, and issued to firms whose names are entered upon its special register. U.K. firms desirous of receiving copies of these reports, together with particulars of the special register service and form of application for registration, should communicate with the D.O.T., 35, Old Queen Street, London, S.W.1 (Reference B. X. 1,070).

Educational.—We have just received a copy of the new programme of the Crystal Palace School of Practical Engineering, to which we have made frequent reference in our columns. The new principal, Mr. Maurice Wilson, A.M.I.C.E., F.S.E., who is a past president of the Society of Engineers, sets forth therein the complete programme of the school work, and he also issues extracts from the addresses by the chairmen on certificate days, which will go far to show the high esteem in which the school is held by men holding leading positions in the engineering profession throughout the British Empire. Upwards of 1,300 students of this school have succeeded in their profession, and many of them are leading lights in the railway world as well as in other of the varied branches of engineering. Three of them at least have become chief electrical engineers, namely, at Bolton, Cardiff and to the L. and S.W. Railway, and yet another is the naval architect to the Chilean Government.

The Value of Good Illumination.—Two first-class examples in the way of illuminating engineering have recently been carried out in Southport and Ipswich by Messrs. Bartrums, Roylance and Co., Ltd., of Manchester, and Wood and Co., of Northgate Street, Ipswich, respectively. In both cases the designs had been prepared by the illuminating engineering department of the General Electric Co., and the results have proved eminently satisfactory. In the former case the installation was at the stores of Alexanders (Southport), Ltd., in which the even illumination is obtained by the scientific application of "Gecoray" silvered glass reflectors, a number of which are fitted with colour screens producing harmonious colour effects combined with spot-lights throwing concentrated beams upon special features in the window display. In the installation at Ipswich, on the premises of Smith and Harvey, tailors, in Butter Market, the very effective illumination was obtained by a number of "Gecoray" reflectors of the "Meteor" type equipped with 60-watt Osram gasfilled lamps, which projected the light from above in the front of the window, thus enabling the firms' goods to be viewed to the utmost advantage.

GRINDERS
DRILLS
"DEPENDABLE"
& POLISHING LATHES
MARRYAT & PLACE, ENGINEERS.
28 HATTON GARDEN, E.C.2.

(REGD) Vulmos GENUINE VULCANIZED FIBRE
MOSSES & MITCHELL, LTD. 122 & 124 GOLDEN LANE LONDON, E.C.

Sample Pair Sent on Approval for 8/6

Made of Pure Para Rubber, soft and durable and unaffected by climatic conditions
DAVID MOSELEY & SONS, Limited.
ARDWICK, MANCHESTER.

MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
A PRACTICAL TRADE JOURNAL

JULY 18, 1924.

CONTENTS.

	PAGE
Situations Vacant and Wanted	367
A New Tapping Switch for Transformers	369
Changes—and Waste	370
Current Topics	373
Asbestos	374
Broadcast Receiving Sets	375
All-British Wireless Exhibition, 1924	376
Questions and Answers by Practical Men	379
Siemens and English Electric Lamp Company, Limited	380
Answers to Correspondents	380
Weekes' New "H.C." Switchgear	380
Reviews of Books	380
Trade Notes	382
Various Items	382

SITUATIONS VACANT AND WANTED.

By a Manager.

From time to time one is startled to read a statement of the total number of million working hours which have been lost through a strike in a certain industry which may only have lasted a very short time. Amazing as such figures are, they would be surpassed were it possible to calculate the number of hours which are regularly lost to the community in the penning of unsuitable and inadequate applications for employment. For fifteen years past, in various engineering businesses, the writer has been periodically called upon to advertise for help of various kinds, for works managers, foremen, designers, draughtsmen, salesmen, travellers, and clerical staff, and his perusal of tens of thousands of resulting applications leads him to think that a few words of advice upon the type of letter which is unsuccessful might conceivably be of service to many an applicant who has been disappointed and mystified by his consistent lack of success.

The first question which arises is: Should the letter be written or typed? The vast majority of the applications one handles are in the applicant's own handwriting; and if the handwriting is so good that it is a pleasure to read, there is no harm done; but a badly written letter is anathema to anyone who is called upon to deal with a large correspondence. Its deciphering is a dreaded ordeal, which is put off until the clearly typed and straightforward correspondence is all safely disposed of. There are establishments in which the repugnance to certain illegible brands of writing is so strong that such letters are clearly copied out by a typist before they receive attention; but these are, of course, letters from customers; not many letters of application would receive such attention. As one whose hard fate it has been for many years to deal with correspondence, almost by the cartload, the writer would strongly recommend the typewritten letter every time. The prospective employer who prides himself upon his ability to judge a man's character from his handwriting, will be able to perform his character-reading trick just as well from the signature as from a two-page letter.

Should the application be long or short? If it is a hand-written communication, by all means the shorter the better, in accordance with the usually accepted rules for brevity in all business correspondence; but if it is clearly typewritten, if the qualifications one can offer are exceptional, and if the letter can be made an interesting one, the applicant need not be afraid of adding another two or three hundred words if necessary to complete his story. One of the shortest applications which the writer ever saw was one received by a large engineering works in reply to their advertisement, the sender of which expressed his readiness to have a personal interview, when the details of his experience, his qualifications, and his testimonials could be discussed.

Common Failings.

It would be a good rule for every applicant if he does not possess the qualifications called for by the advertisement (or at any rate a very close approximation thereto) to save himself the trouble of writing. The writer's experience of letters of this kind goes to prove that generally over half the applicants are unsuitable for the post they are seeking, merely judged from their own particulars. The time which is spent in taking these "long shots" and "sporting chances" would be much more profitably employed in making more careful application for such posts as the applicant's qualifications are more obviously suitable.

Another most important rule is to read and thoroughly understand the advertisement, to note what information is asked for, and to give it. The advice may appear rather common-place, but over three-quarters of the applications which the writer has ever handled fail to give straight answers to the three or four questions which may have been asked in the advertisement. The points upon which information is usually requested are the applicant's age, his past experience, the salary required, when he will be at liberty, and occasionally whether married or single. None of these questions presents any difficulty, but it is safe to affirm that an advertisement which called for information upon half a dozen points such as the foregoing would not succeed in getting more than a dozen or two letters which would answer them all. Apart from the point of courtesy, the furnishing of information which is specifically asked for is good policy. Let the applicant try to place himself in the position of the busy man who has either to make the final or a rough selection for a vacant post. His advertisement, setting forth what is wanted, has probably brought him anything from 150 to 500 replies. Consciously or unconsciously, he is at first anxious to seize upon any pretext for putting the vast majority of these on one side, and it is the failure to reply to definite questions which will furnish him with a reason for eliminating about three-quarters. The argument usually is: We require someone who can be trusted to attend to instructions, and if a man cannot reply to a simple question when his probable engagement depends upon it, what sort of attention will he give to instructions when he is employed? Picture, too, the exasperation of an employer in urgent need of a technical assistant with certain special experience when he finds that every single reply received has blandly ignored the one essential point in the advertisement—and the writer came across such an actual case not twelve months ago!

Many people who will answer a question as to their age, when they are at liberty, or whether they are married, seem unable to state the salary they require. If it is not ignored altogether, the question is possibly evaded with the remark that it "can be discussed at an interview," or something of the sort. I have even known applicants who were rash enough to express their willingness to accept what the advertiser felt disposed to offer. The feeling which many advertisers have about a letter of application which does not state the salary required is that the applicant will probably ask of a large or well-advertised company twice the amount he would be glad to accept from a smaller undertaking, and, whether justified or not, this feeling undoubtedly exists. It must be admitted that many of the wanted advertisements are not too businesslike in this respect, as in many cases there is no clue whatever given to the locality of the post which is advertised, but even then the applicant has the opportunity of showing his business aptitude by stipulating that the remuneration he is asking is £x, on the assumption that the post is in such and such a town or district.

UNSUPPORTED STATEMENTS.

Another frequent failing in many letters of application is for a number of claims to be made of the applicant's capabilities which are unsupported by any apparent evidence. For instance, the engineer who states that he is a fully qualified designer of the latest type A.C. machines stands a better chance of receiving ready credence if he adds that he was personally responsible for the design of the machines manufactured by a certain maker. Similarly, the salesman who claims to "thoroughly understand the psychology of sales and the methods of overcoming sales-resistance" will stand a far better chance of being amongst the two or three selected for a personal interview if he happens to state that for some nine or ten years past he has been the most successful representative for the advertiser's most dreaded competitor. So, too, the clerical employee who claims a knowledge of a certain foreign language would be well advised to state that it was actually acquired by a prolonged residence in that country, rather than let it be imagined he has gained it through a few months' correspondence course!

RETICENCE.

Undue reticence, ambiguous references and allusions are also to be avoided, for they fail to carry weight, such, for instance, as referring to work having been done "for a well-known firm," or service "with a firm whose name I shall be pleased to give you." It is also advisable to avoid such euphemisms as "I am at present employed by a well-known firm, but am resigning my position for reasons which I can better explain at a personal interview." There are not many firms who are prepared to pay a man's return railway fare in order to obtain information of this description. Similarly, a man who states "I voluntarily resigned my position nine months ago in anticipation of improving my prospects" betrays a considerable lack of commercial shrewdness, to say the least of it.

BOX ADVERTISEMENTS.

No doubt one of the main reasons for the reticence and ambiguous allusions which one encounters so plentifully in applications is due to the prevalence of advertisements which merely quote box numbers. It is generally asserted that such advertisements do not bring replies from men of the same high capacity or in such numbers as would be elicited by an announcement quoting the name and address of the advertiser. Though the first part of the assertion is probably correct, the writer has always found the *numbers* of the replies more than satisfactory. In this connection, there are many applicants who are not aware that most periodicals will be found quite considerate towards the applicant who, when replying to such an impersonal advertisement, may be apprehensive of inadvertently approaching his own employer. A request attached to the envelope, "Not to be delivered if the advertiser is Messrs X and Co." will usually receive every attention, but in such cases, of course, the letter would be destroyed, as a request of this description could not be made the indirect means of ascertaining who is the advertiser. Though this course will simplify matters somewhat for the applicant, it obviously does not cover the case where the advertisement may have been inserted by some director or official of the company without divulging the company's name, nor does it cover cases where replies are personally collected by the advertiser at the offices of the paper.

THE LETTER WRITER.

The failings which mark the majority of letters of application are usually avoided if the applicant enlists the aid of a professional letter-writter, whose experience is sufficient to avoid those pitfalls which beset the path of the inexperienced correspondent. The employment of a letter-writing expert can, of course, be defended in precisely the same way as the employment of a solicitor to prepare a deed or an architect to design a house; but though the procedure is strictly legitimate, its practice is to be deprecated in many cases. It has the great disadvantage that, skilfully prepared by someone who is an expert in persuasive correspondence and in the arts of selling either goods or services, such a letter requires a very capable man to live up to its promise. For one of the higher positions, an excellent engineer with the highest technical qualifications may perhaps be selected very largely on account of his apparent genius for correspondence and the elusive arts of salesmanship as exemplified by his letter of application; and though the employment of a letter-writer may have been the deciding factor in securing his client the post, this cannot be retained by the same means if the client does not really possess these qualifications. In such a case, the newcomer is not likely to have a very long shift, and in less than a month's time he may be regretting that he did not trust to his own unaided powers in conducting his correspondence.

QUALIFICATIONS.

When studying the possibilities of an advertisement, and considering the best line of approach, the intending applicant should bear in mind that if it is a waste of time to apply for a situation when one's qualifications are inadequate, it is also true that in many cases the possession of qualifications and capabilities which are too greatly in excess of the average may prove to be rather a hindrance than a help. For instance, when industrial conditions are exceptionally bad, it is quite possible that a fully qualified electrical engineer, a designer and draughtsman with high diplomas and valuable experience, whose value in normal times would be some five or six hundred pounds per annum, might conceivably be glad to accept a situation as storekeeper at some three or four pounds per week rather than do nothing at all. In his letter of application for the latter situation, however, he would be well advised modestly to veil his higher qualifications and experience, the danger being that the average employer is reluctant to select a man whose capabilities are obviously far in excess of the work he will be called upon to perform, fearing that the work might be thrown up in disgust in a very short time, or (what is more probable) that the employee would shortly afterwards secure a situation more commensurate with his abilities after utilising the smaller situation for a few weeks as a convenient stop-gap.

THE INVESTOR.

But there is another class of Situations Vacant advertisement for which we shall require to reverse all our previously-conceived rules. It is a type of advertisement which is becoming increasingly frequent, and if numbers are any criterion, it evidences a decided demand and apparently a fair supply. It usually reads something like the following:—

> "Salary £500. Practical or commercial man wanted by small manufacturers desirous of extension, to take charge of works or sales organisation. Previous experience not absolutely necessary. Investment £600. Box X."

A reply to this advertisement will not need the same high-class letter-paper; it does not call for the services of a skilled typist, nor does it require the same meticulous accuracy of phrasing and style to secure full attention. In fact, all these things, implying as they do a logical and businesslike mind, are in this case a drawback rather than an asset, and the applicant in penning his reply may for the time being throw all cares of composition to the winds. His story of the little windfall from cousin Jane on which he thinks the savings-bank interest so low, his expectations from his aunt Martha, can all be treated at length; neither bad hand-writing nor prolixity will impair his chances of favourable reception. The fact that he has been previously engaged in the sweet and tobacco trade will be no drawback. Even the fact that the aforesaid little windfall is only some three hundred pounds need not deter him. If he is too late in the scramble for the position of works manager, or if another has already secured the post of commercial organiser, he can depend upon it that a business which is about to extend like this one will have other responsible positions for which he will be equally well fitted. The only thing which can possibly impair his chances here is any exhibition of a suspicious or prying curiosity. But in justice to most small investors of this type, it is seldom that their curiosity passes the limits of good taste, and it is startling to note from the reports of police court proceedings in different parts of the country the number of investors of three, four, and five hundred pounds who will put up capital without any investigation.

THE £10,000 A YEAR MAN.

There are sceptics who doubt the difficulty in obtaining men at a salary of £10,000 a year, but it is strictly true. Employers are calling out for them, and are constantly bewailing their scarcity, though it is rarely that one sees such a post advertised. I believe that the firms who are the most vociferous in their complaints of the dearth of such people are the small concerns whose highest paid employees receive some three or four pounds a week, and whose bankers have been so plain-spoken (not to say rude) about the necessity for immediately reducing that overdraft. There are dozens of such small undertakings who are willing and anxious to secure a suitable man and to pay him £10,000 per annum, and the only perfectly reasonable stipulation which they make is that he shall first of all make them about £15,000 as evidence of his capabilities and good faith. Possibly the reason for the great shortage of this type of employee (though I have never seen it given before) is that they are all too busy working overtime in making the £15,000 per annum for themselves to have either the time or the inclination to make it for other people.

SITUATIONS WANTED.

There remains the final question which is often asked: Is any good purpose served by advertising for a post? The writer hopes that he is not offending against any of the accepted canons of advertising if he gives it as his personal opinion that it is very little use in the case of the man with merely ordinary qualifications who is proposing to insert only a short advertisement of some forty words or so. When an assistant of any kind is wanted, an employer's first impulse is not to send out to purchase a few dozen papers in order to study the Situations Wanted columns, but on the contrary he immediately inserts his own announcement as "Situation Vacant." If, on the other hand, a man happens to have some very special qualifications indeed, which are likely to appeal strongly to any particular trade, and if he can afford a number of half-page (or even larger) advertisements in the technical papers serving that industry in which his qualifications can be adequately described, it is probable that such publicity would give him very satisfactory results.

Very much the same remarks apply to the policy of approaching a number of firms with offers of services. It is only the man with some exceptional qualifications, for whom a post might possibly be created, who is likely to reap any marked measure of success from this course; but for such a man the chances by this method would be even greater than by answering an advertisement, for whereas in the former case his communication would receive individual attention, in the latter it would run the risk of being lost or overlooked amongst some hundreds of others.

A NEW TAPPING SWITCH FOR TRANSFORMERS.

The two methods of effecting a change in the tappings of transformers, that is, by bringing them to oil level inside the transfomer tank, or to terminals outside the tank, possess a disadvantage in that the transformer must be switched out or disconnected from the supply before a change in tappings can be made. A further disadvantage of the first method is that the cover of the transformer tank must be raised to give access to the tappings. With the second method live high-tension terminals which are outside the transformer are liable to accidental contact.

To overcome these disadvantages, a patented high-tension oil-immersed tapping switch which can be operated with a minimum of trouble from outside the transformer tank has recently been developed and patented by the Brush Company and is illustrated and described in a new leaflet (200/5-1) which they have just issued. It can be supplied with single-phase or three-phase power transformers of the indoor or out-door type and for electric furnace transformers; in fact, for practically any transformer up to pressures of 33,000 volts.

The switch is operated by means of a tommy bar being inserted in the holes in a spindle; the tommy bar also acts as a pin which forms part of a fool-proof locking arrangement. This locking arrangement only provides for locking the switch in any one tapping position; but not in an intermediate position. Possession of the key of the locking arrangement is essential for operating the switch.

The spindle is connected by means of a nut and thread to rods which carry the moving contacts of the tapping switch; rotation of the spindle therefore raises or lowers the moving contacts. It is also fitted with an indicator, which registers on an indicator plate—fixed to the top of the transformer tank—the voltage of the tapping to which the switch contacts are connected, and the movement of the switch spindle effects the same change in pressure on all phases simultaneously.

The contacts to which the tappings are connected and the moving contacts are so proportioned that no portion of the winding is short-circuited when changing from one tapping to another.

CHANGES—AND WASTE.

By W. J. Hiscox.

The progressive factory undergoes many changes in the course of its life. Things deemed indispensable to-day are upon the scrap heap to-morrow, and in this connection there is woeful waste and extravagance. It is not that changes, both in regard to construction and method, are unnecessary, but too often it is lack of foresight which makes a change imperative, in the eyes of the manager.

The erection of factory offices, and their subsequent demolition, furnishes a case in point, and the following examples may be cited to show how changes are made without regard to the future. In one case, it was decided to build a new stores office, the existing one being considered too small and in the wrong place.

The storekeeper wanted his office right in the centre of the store, instead of at the end, as was the one already in existence. Now, the location of the office is an important matter, and general convenience must be considered, but when a large office is to be erected, and the stores area is already overcrowded, it cannot be said that much discrimination is used when that office is built upon a site which would have been very valuable for storage purposes. As a matter of fact, this aspect was realised by the authorities after the office had been erected, and after remaining in existence for six months, the structure was demolished, and store racks and lockers were erected in its stead.

In another case a foreman applied for permission to erect an office in a certain position, and this was granted, subject to the proposed dimensions being increased. The structure was erected, but no sooner was the foreman installed in his new home than the works engineer descended upon him and demanded to know the reason for erecting an office upon that site.

It appeared that the site had already been selected for the erection of two new machines, which had been purchased and were expected in shortly. Apparently the manager was not aware of this, and the engineer did not think it worth his while to enlighten him until the building was an accomplished fact. Then he stated his case, and to such good purpose that the foreman received notice to quit, and the new and stately building was demolished.

As with constructional changes, so also with changes to the routine. Every new head of a department considers it his duty to introduce something new, and this usually resolves itself into a mass of new printed matter, which supersedes the matter already in existence. After a time it is decided that the new matter is not quite what was wanted, and another departure follows, which has the effect of still further increasing the heavy stocks of useless stationery.

In very many engineering factories there are heavy stocks of discarded forms, and these (if the printing is confined to one side of the paper) are being used as scribbling pads. It is a shame that elaborately prepared documents should be put to such a use, and every effort should be made by the manager and other responsible officials to guard against this abuse.

A new storekeeper comes in, and decides that he requires a brand new set of record cards. These are duly ordered—two thousand or more—and when they arrive the existing record cards are considered obsolete. Probably there is a heavy stock of these, but the fiat goes forth that they are not to be used.

Another extravagance associated with changes is that the demolished buildings, offices and the like, are treated as scrap, instead of the parts being made use of in other directions. An office has just been pulled down and another is being erected, but the timber, etc., from the first is rarely used in the construction of the second. Even door fittings, brackets and the like are not used, new ones being specially ordered, although there are plenty available, and as good as new.

The timber (as it is wrenched down) is stowed away, together with nails, screws, brackets, etc. Well-made doors, window frames, shelves and benches are to be found amongst the "scrap," which will ultimately be "sold" to a dealer for a pound. And all the time alterations and extensions are being made, involving expense which could be minimised considerably by making use of discarded parts. It is worth while keeping an eye on this.

I.E.E. Students' Tour.—Full details have just been issued of the summer tour which is to be undertaken by those members of the London students' section of the I.E.E. who have decided to join the party. It represents an exceedingly interesting itinerary, lasting from Saturday, August 2, to Sunday, August 10, at a total inclusive cost of just over £12. At present over thirty students have signified their wish to attend, and any others who desire to do so should send in their names at once to the Asst. Hon. Sec., Mr. G. R. A. Murray, Chigwell Vicarage, Essex.

"Irish Electrician."—No. 1 Vol. 1 of this new publication is now before us, and from the style and get-up it should most certainly meet with a favourable reception among all in Ireland who are interested in electrical engineering and wireless. One of the leading articles is entitled "People in the Industry," and gives a portrait and biography of Mr. Arthur Edward Porte, who is well-known in the Irish metropolis as a consulting electrical and mechanical engineer. Not only is Mr. Porte's name well-known in Ireland, but it is also well-known to a very large number of the earlier generation of electrical engineers in this country, because it was he who, in conjunction with Mr. (now Sir) Edward Manville, invented the Porte-Manville Electric Governor, of which an illustration is before the writer at the present moment. We wish the new paper every success.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of
CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N. 17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application, Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

The Red Menace.

Apropos the annual meeting of the National Union of Railwaymen, I was astonished to read that the delegates attending this important trade union gathering included one of the leaders of the recent Communist attempt to hold up London's Underground railways. How is it that these eight or nine ringleaders are still apparently at large and have suffered no punishment for their crime? Is it another example of our official apathy over revolutionary tactics by a few emissaries from Moscow designed at overthrowing the British Empire, or is our Labour Government afraid to take such drastic steps as would put a stop once and for all to these frequent upheavals of our social system by a small band of insurgents inspired and financed by Russia? The men who misled their fellow-workmen (*sic*) and caused untold discomfort and loss to Londoners during Whit week have no more right to get off scot free than has any criminal found guilty of an offence against the law.

In the circumstances one can understand the virulent and calculated abuse hurled at the heads of their Labour colleagues now in office by the Clydeside delegates at the N.U.R. meeting. It would be tragic, were it not so feeble and nonsensical, in the eyes of the nation as a whole. An analysis of the funds behind those extremists would be interesting, and it is to be hoped that no feeble-minded Briton with money to burn contributes so much as a threepenny piece towards the loans which the Soviet representatives now in this country are so anxious to raise. It is a foregone conclusion that such money would ultimately find its way into the pockets of the type of individual who foments unofficial strikes, class hatred, and the downfall of the so-called capitalist system. The real British working man cannot study too closely the insidious system which aims at undermining our Empire and producing a Bolshevik state similar to that in Russia.

Only this week I had a long conversation with the British Press representative of a well-known Vienna paper. He is an Englishman who has spent many years of his life on the Continent, knows it thoroughly, and was in Austria and Germany within the fortnight. He tells me that over in Russia England is regarded as the enemy, to be brought low at all costs. Clever emissaries are being sent over here, well provided with funds, to mingle with our workers and spread the gospel of Communism, foment strikes, and generally aim at the destruction and overthrow of all law and order. Well, they have taken something on to breed revolution among our phlegmatic and, in the main, right-thinking British workers, but we shall have to wake up and apply counter-propaganda to defeat the attacks of such mischief-mongers as the Clyde contingent and those who misled the Underground railway employees. I admire Mr. Cramp for his plain speaking at the N.U.R. meeting; he is a strong man, and merits the admiration and support of his union.

Who is the Profiteer?

In connection with the British Empire Exhibition, and more particularly the B.E.A.M.A. or Electrical Section of the Palace of Engineering, is it not anomalous that, in a collective exhibit designed in the main to promote the more widespread use of electrical energy for domestic and industrial purposes, the price charged per unit for energy consumed both by exhibitors and the Dominions for illuminating their exhibits and operating their various electro-mechanical devices, motors, etc., should be exorbitant. Sevenpence per unit for lighting and threepence for power: think of these figures in terms of the Exhibition and what it means in its influence on the smaller exhibitors, unable to make such an effective display as they would wish due to the enormous cost of lighting and power. To run twelve 1,000-watt lamps for an hour entails an expenditure of seven shillings. No wonder the B.E.E. does not offer any very striking blaze of illumination at that price; it simply cannot be done.

Surely it was up to the authorities to supply all essential energy for both power and lighting practically at cost of generation and distribution. It would have been a wiser policy than seeking to make a profit out of the needs of those who have contributed so lavishly to the general success of the undertaking. What a contrast, too, with the price per E.H.P. at which electrical energy is available to the smallest Canadian farmer—£2 10s. per annum. No wonder Dominion visitors are unanimous in pronouncing us very behindhand in the development of the electrical idea. I understand that even those firms who have contributed plant to the power station from which the energy is derived also have to pay these exorbitant rates for such electricity, generated by their own plant, as they consume. Verily we are an extraordinary nation. The enormous consumption of electrical energy at Wembley Exhibition and the comparative steadiness of the load justify a much cheaper unit.

Gold-Fish Days.

"Well, old man, how's the show going?" Thus one stand attendant to another during a recent popular day at the Exhibition. "Oh, pretty well, on the whole, but this is a 'gold-fish' day," replied the other, his comment having regard to the type of disinterested visitor or curious sightseer rather than the keenly observant and "want to know something more about it" type, which is obviously preferred by exhibitors. Rather an apt description, I thought, in view of the open-mouthed, bored attitude of some exhibition strollers. Here's an amusing one from the E.D.A. Electric House. Scene: The Electric Bath Room. *Dramatis Personæ:* Two small boys viewing the electric shaving pot, which is appropriately labelled: "Twenty shaves for one unit." "Eh, Bill, wot's a unit?" "I don't know; kind of safety razor, I s'pose." So much for modern education.

Why Emigration Fails.

Mr. Barnes, Deputy-Director of Immigration at Australia House, stated on his arrival at Sydney that suitable migrants were ceasing to offer themselves in England under the New South Wales Land Settlement schemes. According to Mr. Barnes, everything was done, but without effect, to induce suitable healthy people to migrate. Having listened to an address by two of the leading emigration officials who spoke at Liverpool a few months ago on the same subject, I incline to the opinion that *everything* has *not* been done to encourage emigration to Australasia. Under the schemes outlined at the meeting I attended, only domestic servants, youths for apprenticeship to farmers, and land settlers with moderate capital were encouraged to offer themselves. Now we know what the servant situation is over here to begin with, so class I. is scarcely a likely runner. Secondly, parents as a whole would want to know something about the probable future prospects of their sons before apprenticing them to farmers on the opposite side of the globe, although this scheme is certainly a more promising one than the first. Thirdly, there are very few people with £500 who would be willing to invest it in a land settlement scheme without any experience of what Australian farming implies.

Practically all the emigration schemes I have investigated necessitate the possession of means by the intending emigrants. There's the rub; there are thousands of young, able-bodied and eminently suitable men in this country who could, and would, do well in the colonies if given a fair start, but they haven't a bean; nor any chance of obtaining the wherewithal, honestly, at all events, to qualify as acceptable emigrants. Yet I go so far as to say that if this or any colonial Government anxious to promote emigration, were to promulgate a scheme of assisted emigration whereby young and physically fit men without funds could get to the colonies, and be given a start in a suitable occupation, they would, in a very short while, earn enough not only to keep themselves, but pay back an adequate return on the money they cost to transport and colonise. The trouble with every colony is that it wants the pick of our man-power and preferably the moneyed pick. With over a million unemployed we haven't a large population willing or able to emigrate where the terms are cash in advance.

Tramway Piracy.

We all know the pirate 'bus, which plies over the same route as a L.G.O.C. vehicle, and waxes fat on the intercepted passengers at every stopping place which it succeeds in reaching before its rival, but a pirate tram-car is another order of things which we in this country have never experienced. According to *Travel By Road*, however, a certain Portuguese ran pirate tram-cars over a Lisbon company's rails. His vehicles were designed to wheel easily off the track, and thus avoid obstruction charges. When the company sued for trespass the authorities replied that if they left rails lying in the street they could not object to people using them. In spite of surprise alterations in gauge and type of rail the pirate prospered, and was finally bought out by the established company. It would be interesting to watch the career of a similar pirate on one of our many obsolescent tramway systems in this country.

ELEKTRON.

ASBESTOS.

This material has not had a very long industrial history, but various asbestos firms are advocating its uses and applications as packings, sheetings and jointings in mechanical engineering, while it has uses in the electrical industry—as an insulator it is durable and withstands heat and pressure.

In chemical composition it is a mineral substance, consisting chiefly of silicate of magnesia, with small quantities of other metallic oxides, moisture, and volatile organic matter. The following is the composition per 100 of an Italian sample:—

Magnesia (MgO)	38.0
Silica (SiO_2)	42.0
Oxides of iron and aluminium	5.5
Oxides of potassium and sodium	2.5
Moisture (evaporated at 212 deg. F.) ...	3.0
Organic matter	9.0

It is supposed to have been formed in serpentine rock. The latter may have been pasty at an early period in its history, which, on hardening and contracting, gave rise to the rents. These gradually filled up, and by the influence of enormous pressures, both vertical and lateral, the asbestos assumed the fibrous form in which we find it.

The Italian Alps for some time furnished the asbestos of commerce. Here the cost of obtaining the raw material was great, as it was found in elevated regions, transport was difficult, and much blasting had to be done to remove the useless rocks before the seams were laid bare.

In Canada, in the province of Quebec, asbestos is also found, the composition being much the same as the Italian variety. It is hardly so rich in magnesia, while the oxides of iron and aluminium are in greater quantity; organic matter also is present in greater amount.

It differs also in physical properties, the fibres are shorter and more uniform, while the colour is whiter. It is easily obtained, and with modern machinery, good labour and transport, and the presence of rich veins in the rocks, the industry in Canada made great progress.

There are also supplies in Russia, and the Cape. The former is not so pliable as Canadian, and is darker in appearance, while the yarn made from it is weaker and more brittle. The Cape product is slightly blue in colour and rich in iron oxide. Points in its favour are its low specific gravity and high tensile strength.

For use in the arts and manufactures, the raw material goes through various processes, such as carding (straightening the fibre), spinning (twisting the fibre), weaving (for cloth making), and the making of asbestos paper and millboard.

Among the many products of asbestos are:—(1) Non-conducting composition for boilers and hot-water pipes; (2) Metallic and expansion tape; (3) Salamander joints; (4) Rubesto sheeting and tape; (5) packings for pistons, piston-rods and valve-spindles; (6) thread, twine, rope, gloves, aprons, fibre for gas-fires, felt, putty, cement and drop curtains for theatres.

Other uses to which attention may be directed are as a filtering agent for water and in the treatment of sewage.

BROADCAST RECEIVING SETS.*

By Eric E. Barnett.

(Concluded from page 357.)

REACTION.

Reaction is probably the most fruitful cause of distortion in broadcast receiving sets, and, as it affects not only the enjoyment of the individual listener, but also that of all his "wireless" neighbours as well, it is worthy of consideration in some detail.

The valves, when used in ordinary receiving circuits, may be caused to oscillate if a certain transference of energy takes place between its anode and its grid circuits. This "feed back" of energy may be caused either by magnetic or electrostatic coupling between the anode and grid circuits, and may be intentional or unintentional. Here we will consider only intentionally introduced reaction. Magnetic reaction is usually employed, and is introduced generally by coupling a coil included in the plate circuit of the valve with a coil included in a preceding grid circuit. Used carefully, such reaction increases both range and reaction very considerably, but if too much reaction be employed distortion will inevitably result, and if the set is actually allowed to break into oscillation considerable interference is likely to be caused by re-radiation. For pure reception of local broadcasting reaction should be used sparingly, if at all.

CIRCUITS.

While it is impossible to discuss even a small percentage of the circuits in general use, it is desirable to consider a few illustrative examples. Probably the best and most widely used simple crystal receiver circuit is that employing variometer tuning as shown in Fig. 1. One of the best all-round valve sets, and one which is in general favour, employs one stage of high frequency, a valve detector and one stage of low frequency, as shown in Fig. 2.

Fig. II

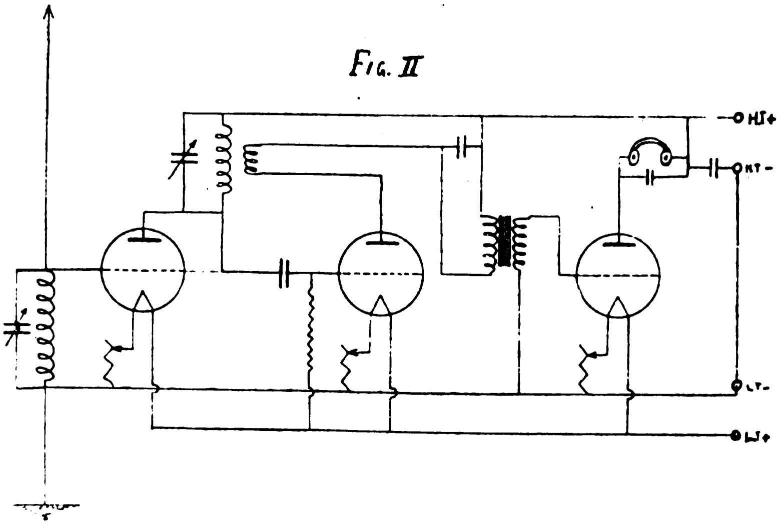


Fig III

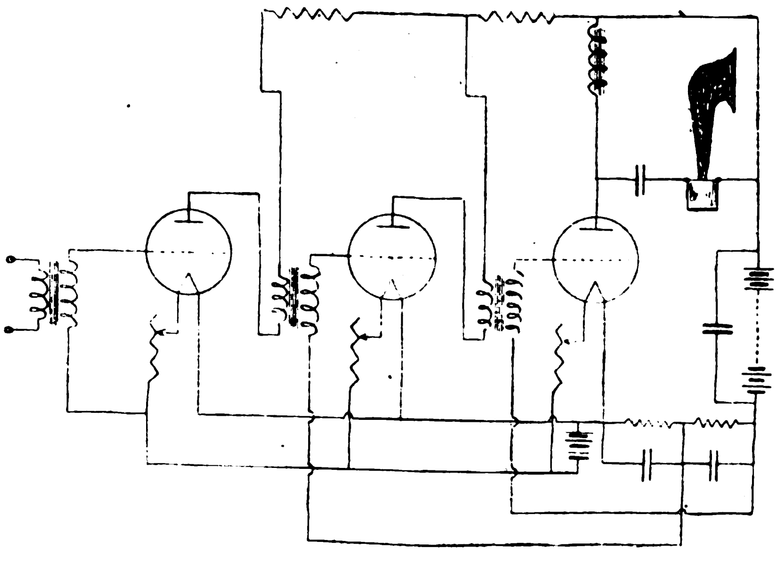
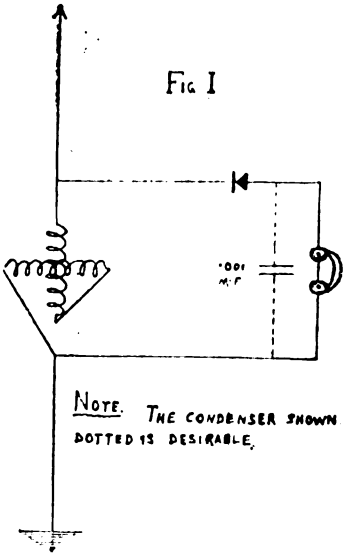


Fig I



Note. The condenser shown dotted is desirable.

---

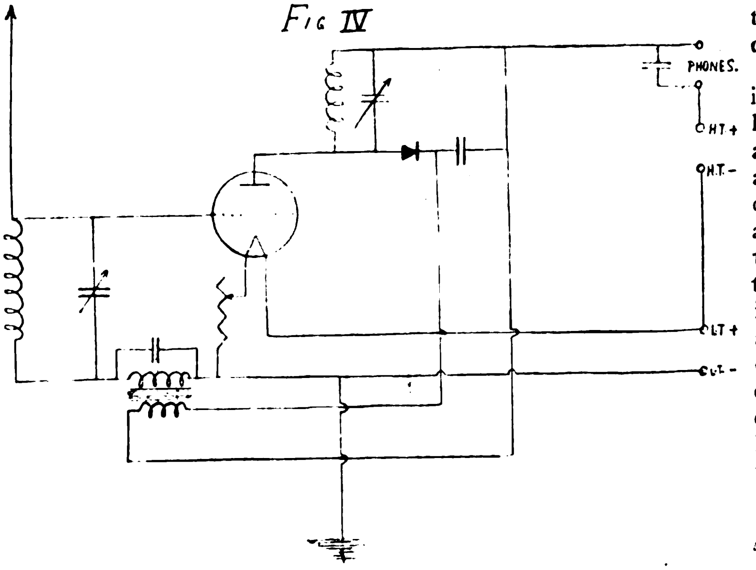
* Paper read before the S.A. Institute of Electrical Engineers.

An efficient and representative low-frequency amplifier capable of producing a large volume of undisturbed sound is shown in Fig. 3.

Recent Circuit Developments.

One of the most useful types of circuit recently developed is that employing "dual" or "reflex" amplification. In such circuits one or more valves are caused to perform the function of both high and low frequency amplifiers simultaneously, and by the use of such circuits great economy in valves may be secured. When properly arranged, these circuits are stable, sensitive and easy to operate, and are becoming more widely used daily. A single-valve reflex circuit with a crystal detector is shown in Fig. 4. Such a circuit will give results almost as good as a standard three-valve circuit.

Fig IV



Another useful circuit is the "Neutrodyne." In ordinary circuits, when several stages of high frequency are used, great instability is usually occasioned by the electrostatic reaction due to the capacity existing between the electrodes of the valves, which acts as a coupling between the plate and grid circuits. In the "Neutrodyne," small fixed condensers are introduced at suitable points in the circuit to neutralise the inter-electrode capacity of the valve and so render the circuit stable without decreasing its sensitivity.

The latest type of circuit used for broadcast reception is the Supersonic Heterodyne. The principle involved is as follows: Incoming waves at frequencies corresponding to broadcasting wave-lengths are heterodyned in the receiver to a lower but still supersonic frequency, and are then amplified at this lower frequency by a long-wave high-frequency amplifier, detection and low-frequency amplification then following in the usual manner. As is well known, radio-frequency amplification at long wave-lengths is much simpler and more stable than radio-frequency amplification at comparatively short wave-lengths such as those used for broadcasting, and the advantages of the supersonic heterodyne method of reception are therefore obvious. Moreover, this system is highly selective, and the controls are remarkably simple.

We are, undoubtedly, only at the beginning of wireless achievement, and the next few years will probably see developments which will render wireless as indispensable a household necessity as the electric light, and one which is no more difficult to control.

Mr. Batey: There is one point I would like Mr. Barnett to give us some information on—that is, with regard to the reflex valve. He tells us that is how to do twice the work. Does that in any way reduce the life of the valves? All I know about it is from what I have seen in the scientific Press. I have never seen anything touching on the life of the valve by using it as a reflex in comparison with using it as a simple valve.

Mr. Barnett: I do not think there can be any possibility of reducing the life of the valve by using it as a reflex. No matter in what capacity you use the valve, you cannot work it beyond its saturation point.

Mr. Williamson: May I ask Mr. Barnett if, with the valve used in dual capacity, there is a possibility of rectifying and eliminating crystals?

Mr. Barnett: Crystal detectors are used as rectifiers in many dual circuits, as they form a sort of isolating link and, therefore, make the set more stable. There are, however, a few dual sets on the market which use a valve as a detector. I have not as yet seen any dual circuits in which the valve functions as a detector and as a high frequency or low frequency amplifier simultaneously. I think the reason is clear: in order to use the valve either as high or low frequency amplifier, it is necessary to work on the straight part of the characteristic of the valve. When you use a valve as a detector it is necessary to work on the bend of the curve. It will not work well as an amplifier in either capacity and as a detector at the same time, because in one instance you need to work on the bend and in the other instance on the straight of the curve.

ALL-BRITISH WIRELESS EXHIBITION, 1924.

The second great exhibition devoted exclusively to the development of wireless, and organised by the National Association of Radio Manufacturers, will this year be held at the Albert Hall, Kensington, from September 27 to October 8 inclusive. The public will be admitted, at a charge, inclusive of tax, of one shilling and sixpence, at 12 noon on the opening Saturday, and thereafter, excepting on the first Tuesday, when the price of admission from 10.30 a.m. till 6 p.m. will be half-a-crown.

It is believed that this is the first occasion upon which the Albert Hall has been used for trade exhibition purposes. A very large floor space is available, and upon this a uniform system of open stands, each on its own raised platform, will be erected.

It is hoped that in addition to the displays which will be made of British radio products—now generally admitted to be the best in the world—the British Broadcasting Company will give a regular programme of demonstrations. During the past year wireless in the British Isles has made immense strides forward in popularity, and it is not too much to say that it has now become an important factor in the life of the nation. The exhibition, it is confidently predicted, will show that an appropriate progress has been made in scope and technique. The British wireless industry, which in this exhibition seeks to give to the public a full and comprehensive idea of what it is doing, is as yet in its infancy. Already, however, it directly employs tens of thousands of British workpeople, and it is satisfactory to record that its products are finding a market in all parts of the world.

Questions and Answers by Practical Men.

RULES.

Questions: We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.

Answers: A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 184.

I would appreciate details of a three-phase 6,600-volt transmission system (overhead). What is the function of the guard wire? What type of earth plates are used? Is every lattice-type pole earthed, etc.?—"FREQUENCY."

QUESTION NO. 185.

I understand that every central station has a potentiometer for calibrating instruments. What are the advantages of this instrument for this purpose as compared with standard instruments?—"JUNIOR-SHIFT."

(*Replies to Questions Nos.* 184 *and* 185 *must be received not later than July* 26, 1924.)

Answers to Questions.

QUESTION NO. 180.

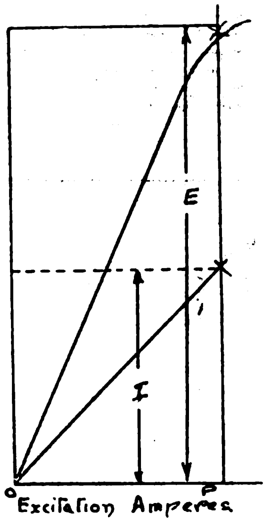
Can any reader inform me how I can obtain the value of the inherent reactance of an alternating current generator? I have no particular make of machine in mind, but current limiting reactances interest me and I cannot get any technical details.—"H. B. HURRY."

The first prize (10s.) is awarded to R. J. Jordan, 41, Thorngate Road, Maida Hill, London, W.9, for the following reply:—

TO DETERMINE INHERENT REACTANCE OF AN ALTERNATING CURRENT GENERATOR.

This may be determined in a very straightforward manner. There are three tests necessary, which will give all data required for the calculation of the reactance of the machine armature. These are as follows:—

(1) *Open Circuit Test.*—The generator is run at normal speed, which must essentially be kept constant, otherwise the frequency will vary. Commencing with no field excitation and gradually increasing it up to full excitation (*i.e.* excitation giving normal terminal voltage) for each successive value of excitation determined by means of an ammeter in the field circuit, the voltage at the generator terminals is recorded by a suitable voltmeter connected across them or across two phases of a multiphase machine. The values of exciting ampéres and terminal volts are plotted on a graph as shown in Fig.



(2) *Short-Circuit Test.*—Again the machine is run at normal speed, with its armature short-circuited through an ammeter of suitable range. Commencing with no field excitation and increasing by increments up to just over full load in the armature, for each increment excitation and armature amps are noted. These values are plotted on the same graph as in the sketch. The graph between these two functions will be a straight line as shown.

(3) *Resistance of Armature.*—This may be done by applying a current from a 4-volt or 6-volt accumulator to the armature. The current and voltage readings obtained will give, by Ohm's Law, the armature resistance.

From the graphs the field excitation corresponding to full load current may be found, and hence the terminal voltage corresponding to this excitation. Let full load current be denoted by I, and voltage corresponding to same excitation by E. Then the impedance of the armature, Z, is given by $\frac{E}{I}$ and $Z = \sqrt{R^2 + X^2}$, where R is the armature resistance and X the inherent reactance. Hence this can be found for $X = \sqrt{Z^2 - R^2}$. Reactance for current limiting may be treated in a similar manner. In the figure OP is the excitation required to produce full load current I. The voltage corresponding to this same excitation is shown by E. It is convenient to plot both graphs on the same paper as shown.—R. J. JORDAN.

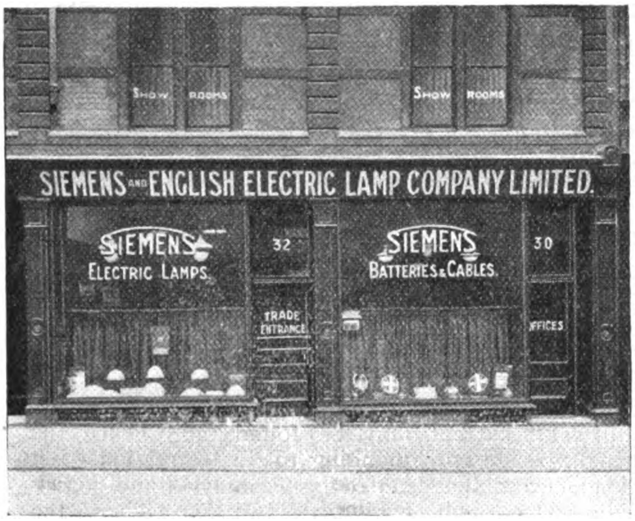
No second award is made.

Card Plan of the B.E.X.—With their usual enterprise the General Electric Co., Ltd., are distributing lavishly a card upon which is printed on one side a complete plan of the Exhibition, with the position of the Palace of Engineering and the G.E.C. Pavilion clearly shown thereon. On the reverse is a cordial invitation from the company to visit the Pavilion of Electricity, and also the exhibit of Fraser and Chalmers' Engineering Works in the south-east block of the Palace of Engineering. Further supplies can be had on application to the General Electric Co., Magnet House, Kingsway, W.C.2, or from any of their provincial branches.

Wembley in Colour.—This is the title of a splendidly produced book published by Messrs. Longmans, Green and Co. dealing at fair length with the great British Empire Exhibition, and illustrated by Mr. Donald Maxwell. It is divided into five sections, namely, "In Africa," "The Golden West," "Lights of Asia," "The Pacific Group," and "Great Britain and Two Islands," and any reader who is unable to visit Wembley may gain a fairly accurate idea of what is to be seen there from the illustrations in this book. It is certainly worthy of a permanent place in any library. Orders can be placed with Messrs. Rentell at their stall in Avenue 15, Bay 14, in the Palace of Engineering, or direct to them at their office at 36, Maiden Lane, London, W.C.2. The price is 21s. 6d. net, post free.

SIEMENS AND ENGLISH ELECTRIC LAMP COMPANY, LIMITED.

We understand that in order to handle the increasing business in the Sheffield area more expeditiously, Messrs. Siemens and English Lamp Co., Ltd., have moved to larger premises at 30/32, West Bar, Sheffield. The whole of the premises are occupied by this company, and comprise a well appointed showroom and stores. Large stocks are held of all types of Siemens electric lamps, fittings, accessories, fuse material and domestic appliances, etc. All the goods are effectively displayed and seen to great advantage in their showroom. The lamp and electrical supplies requirements of Sheffield and the neighbouring towns are well catered for from this branch. Prompt deliveries are made, and all inquiries are dealt with expeditiously.



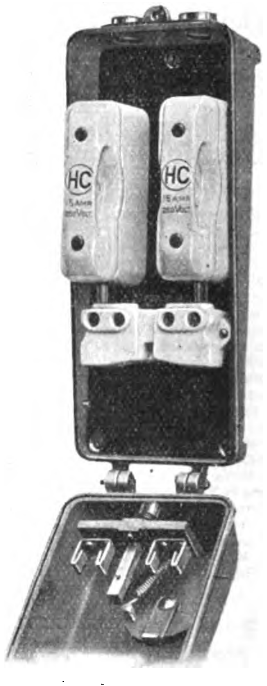
Answers to Correspondents.

T. MALONEY (Cork).—Your suggestion that you can repair the plates of your accumulator with a gas jet is not practicable or economical. An excellent method is to burn the plates electrically with energy from an accumulator of fairly large capacity. Connect one portion of the plate to one pole and the other portion to the other pole and touch them together; this will make a more or less good contact. Then connect one plate to one pole of the accumulator and an arc lamp carbon to the other pole; strike an arc at the newly-made joint and feed with lead.

F. E. HODGSON. — When synchronising two machines, either generators or rotary converters, with lamps, let the phases of the machines be a, b, c, and A, B, C respectively. The connections are a to B, b to A and c to C, lamps being connected to the phases in this rotation. No mistake can be made providing the "star" point is permanently connected. If it is not, then it is possible for a mistake to be made in phase rotation when connecting. This, we assume, is what happened in your case.

Many a man is given credit for generosity who is merely too timid to refuse.

WEEKES' NEW "H.C." SWITCHGEAR.



We are in receipt of details of the "H.C." switch and fuses, manufactured by L. Weekes, Ltd., Luton, Bedfordshire. They are not an alternative to the well-known "Safetee" combined switch fuse, but are a special high-class switch and fuses at a low price for house service use. An exceptional feature of the new "H.C." type is that although primarily designed for use on 250-volt circuits, tests have proved them to be equally satisfactory on 500-volt circuits. As may be seen from our illustration, the chief features are: It has large wiring spaces, is iron clad and foolproof, has a decided quick make and break action, is supplied with substantial vented porcelain fuse-holders and bridges, will carry and break 50 per cent. in excess of rated current capacity (the spring contacts of both the switch and fuse elements being of large section hard drawn and high conductivity copper), and is fitted with screwed insulating bushes which are removable for use with conduit.

We have inspected an "H.C." switch and fuses, and we consider it will meet exceptional requirements.

Reviews of Books, &c.

[*Books noticed in this column will be sent from* ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage* (*minimum 2d.*), *and orders will be appreciated.*]

MASTERS OF SCIENCE AND INVENTION. By F. L. Darrow. Cloth, 8vo, 350 pp. Illustrated. (Chapman and Hall, 10s. 6d. net).—Mr. Darrow is to be complimented on the production of a work giving brief details of the leading scientists and inventors throughout the ages, with particulars of the subjects with which they have been most intimately associated. No reader who aspires to a knowledge of the laws of science and their manifold application can count himself as in any way efficient without the possession of something more than a hazy idea of the outstanding men whose labours and discoveries have helped to make the civilisation in which we now live, and this volume gives an accurate and comprehensive account of them without going into tedious biographical details. Starting with Galileo, who is aptly praised as one of the intellectual leaders of all time, the author takes us on to such great names as Newton and Einstein, Lavoisier and Cavendish, Arkwright and Crompton, Herschel, Faraday, Watt, Stephenson, Morse and Bell. In all about fifty great names are dealt with at length, and in addition brief notes are given of about another fifty-four, some of whom are still among us and may yet add considerably to our scientific knowledge. We can cordially recommend the book to our readers.

THE ELECTROLYTIC RECTIFIERS. By N. A. de Bruyne. (Pitman, 3s. 6d. net.)—While the subject of electrolytic rectifiers has been touched upon in many of the electrical trade papers and scientific journals, no book appears to have been written thereon, and Mr. Bruyne's book will therefore be welcomed by everybody interested in the question of rectification of alternating current. The subject is dealt with very fully from the theory down to the practice, to which may be added some details of construction. To those who have made some study of electrolytic rectifiers the book may not contain much, if any, new matter. It does, however, embody most of the theoretical and practical information that has appeared from time to time, and the chapters on theory are particularly worthy of mention. Indeed, from a general electrical standpoint they are well worth the reader's study, as they introduce technical theories not met with by the electrical engineer during his ordinary routine of work. They may thus serve to widen his knowledge and outlook on the little explored regions between chemistry and electricity. These remarks apply particularly to the storage battery engineer. To the large number of wireless amateurs who wish to use rectified alternating current for quite a number of purposes, the book is specially to be recommended, as it gives practical information on the construction, operation and upkeep of this type of rectifier, which is without question the ideal for amateur use, and by following the instructions given many will succeed in the future where they have failed in the past. There is one point on which a little additional information would be of advantage. A rectifier is described in which the resistant electrodes are of pure aluminium, the tank forming the other electrode. We understand that this arrangement was not entirely successful in operation, due to the corrosion of the tank. It is, however, only fair to the designer to add that, by the addition of carbon plate electrodes, this slight defect has been remedied to very great advantage. In connection with the same instrument, the designer has patented some small modification to the electrolyte which again effects a still further improvement. The descriptions of electrolytic lightning arresters may not be of much practical use to the general reader, but are nevertheless worthy of his attention. In conclusion, there are three suggestions, of which two at least may form the basis of experiment for wireless enthusiasts. One is on the question of electrolytic condensers, and the other the production of alternating current with one or more electrolytic valves, while the third bids fair to be a prophecy of the future, as it deals with the question of glow discharges, and suggests that this may be the light of the future. The book is well printed, and is amply diagrammed and illustrated, and we predict for it a very wide sale.

ELECTRIC ARC AND OXY-ACETYLENE WELDING. By E. A. Atkins. 316 pp., 151 figs. (Pitman, 7s. 6d. net.)—The process of welding in its many forms has now developed into one of the most important of all metallurgical processes, and there seems to be no limit to the kinds of work to which it can be applied. In this pre-eminently practical handbook the author describes fully the different processes of electric arc and oxy-acetylene welding in their various applications, and gives the results of all kinds of tests and experiments. The book teems with practical suggestions, and we attach special importance to the large number of very excellent micro-photographs which show the reader most clearly the structure of different metals in various conditions, and thus enable him to appreciate the problems to be faced in welding and the consequences of correct and incorrect procedure. The author's long and wide practical experience is placed freely at the reader's disposal, and the book is undoubtedly one which inspires confidence and will be very widely appreciated. The production is excellent throughout, and the price is very reasonable.

ANNUAL TABLES OF CONSTANTS AND NUMERICAL DATA: VOL. IV., 1913-1916. Section B—Data on Electricity, Magnetism and Electrochemistry, 150 pp. Section F—Engineering and Metallurgy, 161 pp. (Paris, Gauthier Villars, each part 40 fr. (30 fr. paper cover), also special terms as noted below.)—With this fourth volume, the *Tables Annuelles*, which had already established their reputation before the war, make their reappearance after a lapse of nine years. During the whole of this period the General Secretary of the International Committee and his many collaborators have been working steadily in the compilation of these invaluable tables, and it is a matter for general satisfaction that publication has now been resumed. The outstanding feature of these tables is the completeness and detail with which the results obtained by various authors and research workers are reproduced. Each published research is taken separately, and the tables—and if necessary the curves—in which the author has given his results are reproduced in full. More than 300 periodicals are searched in the preparation of these tables, and in this arduous work the committee has the support of the leading scientific and professional bodies in most of the principal countries of the world. Though Germany does not appear in the list of members of the committee, German periodicals are searched in the compilation of material, so that the reader need have no fear that the work is in any way incomplete.

In Section B (Electricity, etc.), we find a most valuable collection of tables on electrical conductivity; thermo-electric force; dielectric constants; electrical potential, waves, etc.; and photo-electricity. The tables on ferro-magnetism; magnetic fatigue and susceptibility; magnetic rotation; and magneto-chemistry are equally valuable, and indeed indispensable to all research workers and students. Though the main text of the tables is in French, the headings are given in all the principal languages, so that no one need have any difficulty in consulting the work. Section F includes tables on the mechanical properties of constructional materials; physical and chemical properties of fuels and refractory materials; technical data on the metallurgy of metals and alloys; mechanical constants bearing on metallurgy; and also electrical constants.

In conclusion, it should be noted that members of the Institute of Metals, the Institution of Mechanical Engineers, the Iron and Steel Institute, the British Association, or the Faraday Society can obtain these valuable publications at 50 per cent. reduction in price, viz., 7s. in card covers or 5s. 10d. in paper covers for each section.

Trade Notes.

List V.S.2, from the **Mullard Radio Valve Co.**, of Nightingale Lane, London, S.W.12, gives illustrations and full particulars of the latest type of Mullard Silica Valve for high-power transmitting and rectifiers. This should prove of interest to all dealers in wireless supplies, and we recommend application for copies without delay.

Pamphlet 60a, from **Siemens Bros. and Co., Ltd.**, of Woolwich, contains a series of 29 photographs of different sections of the works of this great company, which will enable all who receive it to gain some idea of its importance and the various processes of manufacture of the cables, instruments and apparatus for which the name of Siemens is renowned throughout the world.

The **London Electric Firm**, of Brighton Road, Croydon, with their allied undertaking, the Electric Heating Co., of George Street, Croydon, are issuing a postcard bearing a photograph of their exhibits in the Palace of Engineering at Wembley, and this is being sent broadcast to their clients and friends throughout the country.

The usual monthly price-list of electrical supplies has been issued by the **Siemens and English Electric Lamp Co., Ltd.**, of 38, Upper Thames Street, London, E.C.4, and any trade reader who has not yet received a copy of the July issue should make a point of writing at once to the company and asking for it. It will be sent willingly.

Some installation contractors are already feeling the benefit of the E.D.A. exhibit at Wembley in the way of quiet nibbles about prices of wiring for all sorts of electrical utilities, and heating is, of course, coming in for its share. We would, therefore, recommend all our trade readers to make a point of writing to the **Arora Company**, at Loughborough, and asking for a copy of their "Z" list of electric fires, radiators, etc., for the coming winter season. It is just as well to be prepared for the new business which is certain to come along in the autumn.

From a circular issued by the **Gaumont Co., Ltd.**, of 5/6, Sherwood Street, London, W.1, we note that they have supplied trade propaganda films to quite a number of the leading firms in this country, including Harrods, the B.T.-H. Co., Ltd., the Anglo-Mexican Petroleum Co., Ltd., Thos. Firth and Sons, Sheffield, J. Brown and Co., Ltd., Sheffield, Vickers, Ltd., Crossley Motors, Ruston and Hornsby, the G.E. Co., and a host of other well-known manufacturing undertakings, the list of which is growing steadily This is sure proof of the advertising value of propaganda films, and all who are interested should make a point of writing to the Gaumont Co. and ask for full particulars.

"When Summer Comes" is the title of a new publicity circular which has just been issued by the **E.D.A.** offices, and should be of value to all contractors and dealers in electrical supplies who are anxious to make hay while the sun shines.

A list giving prices of accumulators for wireless has just been issued by the **Accumulator Service Co.**, of Pioneer Works, Forest Street, London, E.7. It is accompanied by a report on their Asco Low Frequency Transformer, setting forth the advantages which are claimed for it. The list should be of interest to all wireless dealers, to whom the company will be pleased to send copies on application.

Two leaflets, dealing respectively with Automatic Pressure Regulators and Automatic Temperature Regulators, have been issued by the **Steam Fittings Co., Ltd**, of West Drayton, Middlesex. They should appeal to all engineers in charge of steam plant, and will be sent willingly on application.

The **Walsall Hardware Mfg. Co., Ltd.**, conduit, etc., manufacturers, of Ablewell Street, Walsall have opened a new depôt under the management of Mr. S. V. Reynolds at West Canal Wharf, Cardiff Tel. No., Cardiff 5414.

The July issue of the *Asea Journal*, issued from the office of the **Swedish General Electric Co**, 5, Chancery Lane, London, W.C.2, gives illustrations of some electric locomotives which have recently been built by the company for the Drammen Railway. Also of motors for those and other electric locomotives, as well as excellent diagrams of the control gear used on the electric locomotives built for the Riksgrans Railway. The journal should interest all traction engineers, and copies will be willingly sent on application.

We are in receipt of Descriptive Leaflet No. 826/1-1, issued by **Metropolitan-Vickers Electrical Co., Ltd.**, which deals with marine electrical equipments. The scope of this leaflet is limited to the presentation of illustrations and brief descriptions of a few typical examples of apparatus manufactured specially for marine service. The apparatus includes special watertight motors, drip-proof motors, vertical shaft motors, main and auxiliary switchboards, etc.

Various Items.

Agency.—We are informed that the Westminster Tool and Electric Co., Ltd., of Westool Works, Putney, S.W.15, have appointed the Autocar Electrical Equipment Co., of Mitchell Street, E.C.1, as their sole selling agents for Westool commutators for automobile use.

Tenders Accepted.—The G.E. Co. have secured the complete contract for a six months' supply of Osram lamps for the G.S. and W. Ry., Ireland.——The Chloride Electrical Storage Co., Ltd., have just booked a contract value £23,410 for the supply of a storage battery of 264 cells, capacity 5,500 amp. hours at the 5-hour rate, for the Hull Corporation, for use at a new sub-station.

Trade Opportunities.—Confidential reports on the market for wireless apparatus in Chile, Uruguay and Paraguay have been prepared by the D.O.T. from information received, and U.K firms desirous of receiving copies of the reports, together with full particulars of the Special Register service and form of application for registration, should communicate with the D.O.T., 35, Old Queen Street, London, S.W.1.

Entertaining Our Guests.—A number of well-known Australians, including Sir Joseph Cook, High Commissioner for Australia, Sir Maynard Hedstrom, of Fiji, Sir John Vicars, of Sydney, Major-General the Hon. Sir Newton J. Moore, George Wright, Esq., of Sydney, E. E. Wagstaff, Esq., of Melbourne, J. Davies, Esq., General Secretary, United Commercial Travellers' Association of Australia, E. W. De Rose, Esq., Past President of the Travellers' Association of Australia, and Col. Spain, of Sydney, who are at present on a visit to England for the British Empire Exhibition, made a two days' tour last week of certain works of the General Electric Co., Ltd., when they inspected the company's Peel-Conner Telephone Works at Coventry, and the Witton Engineering and other factories of the company in Birmingham. They were personally conducted by Mr. Edward Hirst, managing director of the British G.E. Co., Ltd., of Sydney, who is also at present on a visit to England.

The Arcadia Projector.—We recently had the pleasure of attending a demonstration of the new Arcadia Projector at the private theatre of the Research and Development Co., Ltd., 27, Soho Square, London, W.1. Our impressions are that the Arcadia Projector overcomes many of the defects which are inherent in the old-style projectors The underlying scientific ideas are entirely new, the **Arcadia** providing for itself the optical delusion. In other words, what up to now the human eye has had to accomplish, at the cost of considerable nerve strain, the Arcadia Projector does mechanically, by causing the light of one picture to fade away on the screen, while the next following picture comes into the light, thus providing the perfect illusion of the continuous movement without any flicker One outstanding feature of this projector is that there is no shutter. This means a 100 per cent. illumination upon the screen, and, therefore, a reduction in current consumption can be effected.

An Engineers' Memorial.—On Saturday, July 12, at 3.30 p.m., Major-General Sir Gerard Heath unveiled, and the Dean of Westminster dedicated, a memorial to those members of the London Electrical Engineers' Territorial Force who died in the Great War; the London Electrical Engineers' Territorial Force is now the 27th Anti-Aircraft Battalion, R.E. In unveiling the tablet, which is on the wall of the entrance porch of the headquarters of the battalion, and immediately facing a similar tablet commemorating the men who fell in the South African War, Major-General Heath observed that the ceremony brought back to all various recollections of more than six years ago. To the majority the memories were sacred. He recalled the great good fellowship which existed and the exceptional bravery which had been displayed in France, the outstanding feature of which was the cheerfulness with which one and all did the work allocated to them. He said that it was natural for the Britisher to be cheery under such circumstances, and, in his opinion, it was this cheeriness which had brought forth that good-fellowship and comradeship which was an incentive to bravery. The "Last Post" and "Reveille" was sounded by the buglers, and the singing of the National Anthem brought the proceedings to a close.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

JULY 25. 1924

CONTENTS.

	PAGE
The Electrical Kitchen for Private Houses	383
The Social Side of the World Power Conference	385
Marconi Commercial Service Receivers and Accessories ..	385
Telegraphy	386
The New York Radio World's Fair	386
Current Topics	389
Our Overseas Guests	391
Correspondence	392
Questions and Answers by Practical Men	393
Reviews of Books	393
Various Items	394

THE ELECTRICAL KITCHEN FOR PRIVATE HOUSES.*

BY PROF. H. BOHLE, M.I.E.E.

1. GENERAL REMARKS.

It is somewhat remarkable that, in spite of many of the advantages which electric cooking offers, comparatively few homes, even in the larger towns, are equipped in this respect. Durban is probably the only town in this country which makes an exception, largely due to the enterprise of its City Electrical Engineer. I doubt whether even 5 per cent. of all houses in most towns do their cooking electrically, though hot plates, toasters, kettles and irons are found fairly frequently, to be used mainly in cases of emergency. Some people who tried electric cooking gave it up again on account of excessive repair bills and the inconvenience connected with the burning out of elements. This shows that there must be many defects still connected with electric cooking appliances and room for considerable improvements. With this in view, I commenced a series of investigations, not so much from the standpoint of the scientist, but in close collaboration with the master of the kitchen—the housewife.

2. REQUIREMENTS FOR AN UP-TO-DATE KITCHEN.

Electric cooking utensils are not of much use unless they are so simple that they can be placed in the hands of an inexperienced and often thoughtless person, the general servant. In this country many coloured servants cannot even read, yet they ought to be able to use the appliances without disastrous results. The cooking utensils must, therefore, be :—

(*a*) Practically foolproof.
(*b*) Easily repaired in cases of burn-outs, without having to send the utensil away every time.
(*c*) Durable and must not be attacked by rust.
(*d*) Of low capital cost.

It would appear that some of these requirements contradict one another, yet that need not necessarily be the case. If houses are built with the intention of solely using electric cooking and heating, it will be found that the original outlay will be considerably less than for cooking and heating with coal. The chimneys may even be left out entirely, as effective ventilation may be obtained more economically. Building a seven-roomed house in this country entails an outlay of at least £100 for chimneys, ovens, pots and pans, etc., whereas, for electric cooking, a sum of about £60 to £70 should pay for the wiring and the whole electric outfit, including two ovens, two hot plates, a grill, a toaster, an iron, a kettle, all pots and pans and a geyser for water heating.

In the course of more than a year I have tested and tried a good many apparatus from all parts of the world, and, while some utensils were very satisfactory, many have been manufactured by people who never used them themselves. Either the appliance was very heavy and had a very low efficiency, or it had to be unsoldered in order to be able to get at the element, or water finally got into the element causing burning out, or the connections were faulty. As a result I commenced to construct new apparatus, based on the experience gained, which were tried in our own kitchen and which are used with very satisfactory results. In addition our fuel bill for cooking has been reduced from about £1 10s. per month to about £1, at a cost of 1½d. to 2d. per unit.

3. MATERIALS USED FOR COOKING APPLIANCES.

For a current of 1 ampere and a resistance of R ohms, the power absorbed is I^2R watts. Hence for a given current at a stated voltage, the quantity of resistance material required is the smaller the greater the specific resistance of the material employed, since $R = Pl\,S$, where P is the specific resistance, l the length of the conductor and S its cross section. Obviously we must employ a material with a high P, although this alone is not sufficient. The substance must also have a high melting temperature, so that it can be run at a high temperature under normal working conditions. The power I^2R is converted into heat, due to the moving electrons colliding with other atoms and thereby parting with their kinetic energy. This heat, shown by a rise of temperature, must be communicated quickly and efficiently to the material which is to be heated, such as water, food, etc. If W_1 is the weight of the food or water, c_1 its specific heat, d_1 the temperature rise, t the time, W_2, c_2, etc., the corresponding values for the heating element, pot, hot plate, etc., then the energy equation reads :

$$W_1c_1d_1 + W_2c_2d_2 + W_3c_3d_3 + \ . \ . \ . = 0.239\ I^2Rt.$$

It is obvious that for a high efficiency all members, after the first one on the left, should be small, so that we must employ for the appliances light articles with low specific heats, and also see that the temperature rises of all substances except of the element itself, and of the food, are low, which means that the insulation against heat must be effective. Table I. gives information as regards materials used for electric cooking utensils :—

TABLE I.

Material.	Spec. Weight.	Heat conduction. Average.	Spec. heat.
Aluminium	2.6	0.487	0.21
Copper ..	8.9	0.9	0.094
Brass ..	8.6	0.139 to 0.278	0.092
Nickel ..	8.7	0.139	0.11
Iron ..	7.8	0.11 to 0.14	[illegible]

---

* Abstract of paper read before the S.A. Inst. of Electrical Engineers.

We see from this table that for a given volume of cooking vessel, aluminium gives the best result. It has also a high heat conductivity, which is an advantage where heat should be passed on quickly, but a disadvantage where this is to be avoided.

In connection with aluminium, it must be mentioned that repeated heating makes it very soft, so that a heavier cross section has to be employed in the case of tops for hot plates, if buckling is to be prevented. The heating advantage of aluminium is thus somewhat lost as regards hot plates. Aluminium cooking vessels are easily made strong enough, and they possess the further great advantage of cleanliness and non-oxidation. For these reasons aluminium vessels are always preferable. As the oxide of copper is poisonous, this metal cannot be used for cooking vessels, unless the copper is tinned.

The heating element proper has to be insulated electrically. Unfortunately most electric insulators are also poor heat conductors, so that the transmission of heat from the element to the food is impeded. Between the heating wire and the vessel proper we should therefore employ those substances which conduct heat best, such as glass, quartz, mica, porcelain, cement, whereas in a direction which shall carry little heat we should use asbestos, paper, wood, rubber where it can be used at all, silk, still air, etc. Table II. gives information about the heat conductivities of insulating materials, some at different temperatures.

than circular ones for the same cross section. On the whole these alloys last fairly well in air as long as they are not subjected to an excess of steam. To prevent oxidation the wires are frequently cast in a kind of cement, in which case, however, the whole element becomes useless when the wire burns through. Moreover, non-hygroscopic cements are unobtainable, and there are none which do not contain chemically bound water, which becomes free when the element cools down. Of all cements used, cement-asbestos has proved best.

To obtain a durable element it must normally not be worked at too high a temperature. For chrome-nickel the working temperature should lie between 500 and 600 deg. C., so that there is a considerable margin. When such an element is bedded so that it can easily part with its heat throughout its whole length, and is protected against steam and water, it should last many years. When the heating wire is badly bedded, even only in places, the heat generated in these parts is not sufficiently rapidly conducted away, with the result that the heat is employed to raise the temperature of the wire. This is one of the principal reasons for the burning out of elements. The connections from the heating wire to the terminals should be made with stout copper wires, welded properly to the heating conductor. Frequently the heating wire is brought directly to the terminal, which is bad practice, as a poor connection results in local heating.

TABLE 2.

Material.	50°C.	100°	200°	300°	400°	500°
Asbestos	0.43	0.464	0.50	0.517	0.533	0.55 $\times 10^{-3}$
Silicia composition for steam pipes ..	0.20	0.217	0.255	0.296	0.33	$\times 10^{-3}$
Still air	0.058	0.065	0.077	0.0886	0.10	$\times 10^{-3}$
Cement	0.7 $\times 10^{-3}$ average.					
Jena glass	1 to 2 $\times 10^{-3}$,,					
Silk	0.22 $\times 10^{-3}$,,					
Sawdust	0.12 $\times 10^{-3}$,,					
Paper	0.3 $\times 10^{-3}$,,					
Marble (white)	7.1 $\times 10^{-3}$,,					
Porcelain	2.5 $\times 10^{-3}$,,					
Quartz	Parallel to axis 30 $\times 10^{-3}$, across axis 16 $\times 10^{-3}$					
Mica	1.8 $\times 10^{-3}$					
Pine wood	Parallel to grain 0.28 $\times 10^{-3}$, across grain 0.083 $\times 10^{-3}$					
Slate	4.7 $\times 10^{-3}$					

In the case of automatic ovens it is advisable, or even necessary, to surround the oven with a kind of insulating material which not only prevents radiation, but stores a certain amount of heat to finish the cooking after the current has been switched off. Air insulation in place of material lagging is then not sufficient. A lining consisting of closely packed wood shavings has been found suitable for such ovens.

The heating element usually consists of flat or circular nickel-chrome wire, but nickel-iron and silica-carbides are also employed. Nickel-chrome has a tensile strength of 75K./mm², a density of 8.26, a specific resistance of 1.10 ohms per metre length and square-millimetre cross section at 20 deg. C., and a specific heat of 0.1. Its temperature coefficient is 0.000 25, and it melts at about 1,500 deg. C. The figures for nickel-iron (Kruppin) are 60, 8.1, 0.85 for tensile strength, density and specific resistance respec- Flat wires have a greater heat-emitting surface

The search for high-resistance materials led to the use of second-class conductors. Siemens make use of an invention by Dr. Egly, whose resistance material consists of a silica-carbide to which free silicon is added. The substance is made by means of suitable carbonisable binding materials in any desirable form, and then heated in an electric furnace at a sufficiently high temperature until the carbon and silicon combine, the sintered mass becoming homogeneous and non-porous. The material is called *silit*. It can be worked at a temperature of 1,200 to 1,400 deg. C., when its specific resistance is 1,000 to 1,400 ohms per metre length and square-millimetre section. It does not crack when cold water is poured over it.

In the case of large boilers the heating elements are abolished altogether, and the electrodes, mostly of cast iron, simply dip into the water. Such boilers can, of course, be used with alternating currents only, as direct current would decompose the water. As water has a negative temperature coefficient, the current has to be regulated, which is accomplished either by altering the level of the water or by reducing the contact area of the electrodes. Boilers of this type are to-day constructed for directly connecting to 15,000 volts.

(To be continued.)

THE SOCIAL SIDE OF THE WORLD POWER CONFERENCE.

Before leaving England, the overseas visitors to the World Power Conference passed a formal resolution expressing, in warm terms, their appreciation of the hospitality extended to them while they were here; and a short account of the chief of the various functions to which they were referring may be of interest.

As everyone knows, they began on June 30, with the reception of the delegates at Wembley by H.R.H. the Prince of Wales, whose happy and well considered speech of welcome was one of the most quoted utterances of a Conference which, for ten days, put forth a great variety of documents rich in good quotable material.

The reception was followed during the evening of the same day by a banquet given at Queen's Hall, of which an account appeared in our issue of July 11.

After a 24-hours' breathing space the chief delegates attended (July 2) a very delightful dinner given at Lancaster House by His Majesty's Government, and presided over, in the absence of the Prime Minister, by Mr. Clynes, which was followed on the 3rd inst. by a dinner given to the delegates by the U.S. National Committee at the Hotel Cecil where Mr. Merrill (Federal Power Commission), Chairman of the U.S. Executive Committee, was in the chair. On the next day, July 4, the Canadian National Committee gave a luncheon to the delegates at the Hotel Victoria, where Mr. Dunlop was called upon for the first time for a speech, and gave an admirable account of the inception and growth of the idea of a world-conference on power. The Hign Commissioner, Sir Peter Larkin, was in the chair.

On the 5th inst. the delegates had the honour of attending His Majesty's garden party at the Palace, when the following representatives of the conference and ladies were presented:—Mr. and Mrs. Longbottom (Great Britain), Mr. D. N. Dunlop (Great Britain), Dr. and Mrs. S. Z. de Ferranti (Great Britain), Col. and Mrs. R. K. Morcom (Great Britain), Mr. and Mrs. J. B. Challies (Dominion of Canada), Mr. Russell Sinclair (Australia), Dr. H. J. van der Bijl (South Africa), Mr. and Mrs. Samuel Insull (U.S.A.), Mr. and Mrs. O. C. Merrill (U.S.A.), Mr. and Mrs. H. C. Levis (U.S.A.), Mr. and Mrs. Guido Semenza (Italy), Herr Oskar Taussig (Austria), Mr. Em. Uytborck (Belgium), Mr. T. C. Thomsen (Denmark), M. Genissieu (France), Dr. O. von Miller (Germany), Mr. J. G. Bellaar Spruijt (Holland), Don José A. de Artigas (Spain), Mr. F. V. Hansen (Sweden).

On the 8th inst. the Swedish National Committee gave a luncheon to the delegates at Wembley, which was followed in the evening by a conversazione given by the Italian National Committee. On the evening of the 9th inst. there was a conversazione given by the Institution of Civil Engineers, and on the 10th inst. a luncheon by the Institution of Electrical Engineers, and a conversazione by the Royal Society, to all of which the delegates accepted invitations.

On Friday, the 11th inst., the Kelvin Centenary banquet was given at the Connaught Rooms, with Lord Balfour in the chair, all the chief delegates being in attendance. At this function, Dr. Kenelly, of Harvard, in a capital after-dinner speech, paid some very hearty compliments to the "charm and business-like precision" with which English social functions are conducted.

On Saturday, the 12th inst., the festivities were brought to a close with a dinner to several of those who were prominent in organising the conference, given at the Japanese Embassy in native Japanese style and with due ceremonial.

MARCONI COMMERCIAL SERVICE RECEIVERS AND ACCESSORIES.

We have received from Marconi's Wireless Telegraph Co., Ltd., Pamphlet No. 230, dealing with the company's commercial service receivers and accessories.

As we have before indicated, this series of pamphlets are most instructive and interesting, and very clearly outline the methods and design of the apparatus for which the Marconi Company has a world-wide reputation.

The value of the Marconi system is known particularly in commercial circles, but it is necessary to read carefully through a pamphlet such as the one under discussion in order to realise the extensive sphere and application of the Marconi Company's commercial service.

Pamphlet No. 230 describes how commercial messages are received, it gives the general considerations governing the position of the receiving station and its traffic office, and gives a range of exceptionally well-produced illustrations covering the text. The general technical considerations of commercial service are outlined, from atmospherics and jamming, directional selection, down to damping of receiver circuits and speed of working. A number of commercial receivers are illustrated and described in some detail, following which are notes on valve bridges, recorders, etc.

Throughout the book one is struck by the obvious care given to the smallest details of construction, and also by the very necessary complication of receiving circuits necessary for uninterrupted commercial reception.

A Trade Opening.—A report has been issued by the D.O.T. on the market for small power driving craft and engines in Norway, and it looks as if English firms should be able to do good trade therein if they follow it up energetically. Those who are desirous of receiving a copy of the report should apply at once to the D.O.T., 35, Old Queen Street, London, S.W.1, quoting reference A.X.1100.

An Advertising Novelty.—Visitors to Wembley must not be surprised if they find that many of the employees on the stands in the Palace of Engineering are engrossed in a game of roulette, using the advertising novelty which is now being issued by Messrs. Siemens Lamp Co. It is quite a nobby idea, and is certain to create a great deal of interest and amusement. Full particulars may be obtained from the company at 38-9, Upper Thames Street, London, E.C.4, and we would most cordially recommend all trade readers to communicate with them at once, or to make a point of asking to see it when they are next visiting the Palace of Engineering at Wembley.

TELEGRAPHY.[*]

Being solutions to the questions set at the Grade I. examination in Telegraphy held by the City and Guilds of London Institute, on April 30, 1924.

(Continued from page 299.)

Q.—State Ohm's law. How many cells each of 1.4 volts electromotive force and 3 ohms internal resistance are required to send a current of 20 milliamperes through an external resistance of 1,340 ohms? What would be the potential difference at the terminals of the battery when the current is flowing?

A.—Ohm's law states that the current in any circuit varies directly as the electromotive force and inversely as the resistance, or

$$I = \frac{E}{R} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where I is the current in amperes, E is the electromotive force in volts, and R the resistance in ohms. (1) may also be written—

$$R = \frac{E}{I}$$

or

$$E = RI.$$

Let n be the number of cells, e and r the electromotive force and resistance respectively of each cell, and R_1 be the external resistance.

Then the total electromotive force $= ne$ volts, and the resistance of the battery $= nr$ ohms. By Ohm's law

$$I = \frac{ne}{nr + R_1}$$

We require to find n. Multiplying both sides of this last expression by $nr + R_1$, we have

$$Inr + IR_1 = ne$$

i.e.,

$$n = \frac{IR_1}{e - Ir}$$

Substituting the given numerical values—

$$n = \frac{\frac{20}{1{,}000} \times 1{,}340}{1.4 - \frac{20}{1{,}000} \times 3}$$

$$= 20 \text{ cells.}$$

The potential difference at the terminals of the battery when the current is flowing is equal to the product of the current and the external resistance, *i.e.,*

$$V = IR_1.$$

where V is the potential difference at the terminals of the battery, or

$$V = \frac{20}{1{,}000} \times 1{,}340$$

$$= 26.8 \text{ volts.}$$

(To be continued.)

Even a captain of industry is likely to be a private in his home.

THE NEW YORK RADIO WORLD'S FAIR.

The First Radio World's Fair, to be held in Madison Square Garden, and the 69th Regiment Armoury, New York City, September 22 to 28, is attracting the serious attention of the radio geniuses of the world, and scores of them are preparing to introduce their latest inventions at the coming exposition. The managers have been compelled to enlarge the "New Inventions Section" to a size which will allow the exhibition of one hundred devices. Among the noteworthy American discoveries to be shown will be at least three different instruments designed for the purpose of radiocasting photographs in motion. Europe will also be well represented in this department. Several Continental inventors will display new inventions of a most unusual character.

Half a dozen recognised wireless engineers are now busily engaged in trying to perfect systems for radio-ing pictures, and Messrs. Hermann and Kerr have high hopes of being able to broadcast the world's first programme of "Radio Motion Pictures" on the opening night of the exposition.

Sixty nationally known manufacturers of the United States will have *de luxe* exhibits, and England, France, Belgium, Italy, Switzerland and Austria will have proper representation in the "Foreign Section."

Every afternoon and evening there will be a series of almost unbelievable overseas tests, in which Miss Edith Bennett, the famous young American concert star, will participate. Miss Bennett is well known to the radio enthusiasts of every land because of her now historical trans-Atlantic recital, last year, which was heard by millions of people in a hundred or more countries.

The International Amateur Builders' Contest is assuming such huge proportions that the show management expects this feature alone to fill the entire basement of Madison Square Garden. Blanks for this competition are being distributed by radio dealers here and abroad, and entries are already coming in from all parts of the world. Twenty-five prizes will be awarded in this interesting contest, and entry blanks with full particulars will be supplied to all who write direct to General Manager James F. Kerr, Hotel Prince George, New York City.

Edinburgh and Lothians Electricity District.—The Electricity Commissioners have made an Order giving effect to the scheme approved by them, and it has been submitted to the Minister of Transport for confirmation.

Sweden.—We understand that wide-spread interest in the British Empire Exhibition is being taken amongst all classes in Sweden, and the June issue of *Swedish Export*, which has just reached us from the Swedish Consulate-General in London, contains two articles on this particular subject, one of which is written by the British Commercial Attaché in Stockholm. The issue should be read carefully by all who are interested in the promotion of British trade. The annual subscription to the paper is only 6s., including postage.

A London Agency.—The Arora Co., of Loughborough, who are specialists in the manufacture of electric fires and cookers, have appointed Messrs. The British Electric Equipment Co., Ltd., Amberley House, Norfolk St., London, W.C.2, as their sole agents for London and district. The directors of this company have been associated with electric heating and cooking for a great number of years, and are quite prepared to give immediate attention to any electrical inquiries which may be sent to them.

---

[*] Books recommended are:—*Questions and Solutions in Telegraphy and Telephony, Grade I.,* by Few (Rentell, 5s. 10d., post free), and *The Telegraphists' Guide,* by Bell and Wilson (Rentell, 3s. 10d., post free).

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of
CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N. 17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application, Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

A Question of Nomenclature.

In a recent attack upon its own leaders by the Clydeside contingent of the Labour Party, one, Figgins, a signalman, stated that Mr. Wheatley's housing policy was not for the "workers," but for the "middle class." It would be interesting to hear Mr. Figgins' respective definitions of the two classes in regard to their places in the social scheme of to-day. My impression of the average so-called middle-class man and woman is that they *work* far harder and far longer hours than the "workers" so glibly rolled off Mr. Figgins' tongue. The average middle-class wage or salary earner has no trade union to voice his grievances or to incite him to come out on strike whenever the fancy takes him; he just works on uncomplainingly, and more often than not for many hours after Mr. Figgins and his co-workers are taking their ease at the end of a statutory eight-hours day.

In any case, where would the Figginses and others of the Clydeside extremists be without the maligned middle classes? If Mr. Figgins only knew it, the class he so ingloriously labels is the backbone of this country, without which neither trade, industry nor commerce would be possible. I am not out to foster class antagonism—far from it—but I cannot stand by and not lift my pen in defence when such absurd and ignorant statements are made by a representative of that class which is at present doing its best to undermine the British constitution. In the circumstances, I am very glad to see this challenge taken up by a newspaper correspondent, who very properly asks: "Does Mr. Figgins believe that working signals for a fixed number of hours per day is any more arduous than the work of a doctor, editor, shopkeeper, lawyer or research worker, to name a few of the vast number of members of the middle class who are doing useful, necessary and exacting work demanding far more ability than that required for working signals?" Well, Mr. Figgins, what about it?

Village Telephones.

Correspondence which recently appeared in the Press directs attention to the need for greatly extended telephone facilities in remote country villages and agricultural districts where communication is difficult, and especially in cases of emergency, such as calls for doctor, police, etc. Concurrently with this agitation appears a paragraph purporting to emanate from a Post Office official to the effect that there is a loss of between £60 and £70 a year on each rural telephone exchange. That may be so under present conditions, for the simple reason that operators are required to be in attendance however sparse the traffic, and the consequent expense for human attention is incommensurate. With the Community Automatic Exchange, however, there is no need for any operator, and only for very occasional maintenance visits. I referred to this subject some time ago, and urged the Post Office to adopt the Strowger Community Automatic Exchange on a more liberal scale, with a view to meeting the rural telephone service problem. Now that the Department has definitely decided its London policy, it may have time to devote a little more attention to this other very pressing phase of the service.

Making Railway Travel Attractive.

I am glad to see that one or two of the delegates at the World's Advertising Convention at Wembley are courageous enough to admit that the falling off in railway travel is partly due to the fact that the companies utterly ignore the comfort of passengers. Overcrowding of carriages is now looked upon as commonplace and part of the regular daily penalty for travelling by train. Nor do some of the companies recognise the natural desire of tired people to sit down in their stations; that is, if one may judge by the sparsity of seats on the average station platform. In fact, due mainly to apathy, we are rapidly becoming a nation of permanent stand-ups and losing our inherent right to rest when tired. Wembley Exhibition and its approaches afford a striking instance of this tendency to rob the public of its birthright. If you travel thither by Metro. at rush hours, it is ten to one you will have to stand for the whole or part of the journey. When you arrive you essay to "do" the Exhibition thoroughly, which again involves considerable and tiresome walking.

During the day you desire to sit down, and are mulcted in twopence for every four hours, or less, that you remain seated. At the end of the day you again leave by Metro., and, if lucky, succeed in catching an immediate-connection, which will probably entail another standing journey as far as Baker Street. On the other hand, if you have to wait five minutes or so for a train, there are practically no seats for more than a dozen people on any of the four platforms at Wembley Park. Thus, if your luck is out, you may spend the whole of a Wembley day, including the journey there and back, on foot, and you probably won't want to do it again. The absolute limit was reached last week, however, with the opening of the new dance floor round the Government Building bandstand, where a shilling is charged for admission and twopence for a chair to sit down after dancing. And the public paid! All I can add is that they deserve to stand.

This making capital out of human exhaustion is an insidious process which is slowly, but surely, getting a grip on the Londoner. Starting with chairs in the parks, for which a perfectly fair and legitimate charge has been made for years, the principle is now being extended to all sorts of places where crowds foregather, and the chair toll collector, with his roll of tickets and punch, is almost as familiar as the tramway or omnibus conductor. Concurrently, municipal authorities and railway companies are cutting down their allowance of free seats in the parks, open spaces, railway stations, etc., thereby practically playing into the hands of the enterprising purveyor of chairs for everybody. One admires the enterprise which caters for a weary public, and makes a fortune by so doing, but there are limits to the exploitation of the populace, and this seems to be a case calling for reform before we are driven to the expedient of standing all our lives or paying the piper.

The Dynamicables.

The recent dinner of this famous social organisation was graced by the presence of a number of guests from the International Electrotechnical Commission now in this country, and, although as usual delightfully informal, afforded a splendid opportunity for the foregathering of many home and overseas notabilities in the electrical world. "Young" Col. Crompton was in the chair as the guest of honour, and another visitor was Dr. Elihu Thomson, both of whom made humorous speeches, the former being in a particularly juvenile vein. Other speakers who enlivened the proceedings, following an excellent repast, were Messrs. Kingsbury, A. H. Preece, Dr. Ferranti, Sig. Marco Semenza, J. S. Highfield, and several of the overseas visitors. Most of the latter were anxious to assure us that, although domiciled abroad, they were in the main born in this country; thus it may be news to my readers that Dr. Elihu Thomson was born in Manchester, and recalled an early exhibition held at Trafford in the 'sixties. Col. Crompton put in a plea for the youngsters at Wembley, where they have been labelled a bit of a nuisance; instancing his own recollection of the great exhibition of 1851, the memory of which is still fresh in his mind. He very rightly contended that the child of to-day should have an equal opportunity of memorising the present great Empire Exhibition when he came to man's estate.

Bells.

No doubt you have heard the story of the visitor to a well-known country village with a fine peal of bells, who remarked on the excellence of the ringing to a somewhat deaf local inhabitant. After three attempts at making the yokel understand him, the latter pleaded in extenuation of his non-comprehension that "He couldn't hear the gentleman's remark because of those d——d bells." Well, this somewhat forceful criticism does not apply to the very musical and effective carillon installed in the clock tower of the Vickers Research Building in the Palace of Engineering at Wembley. If you have not yet heard these musical chimes you should certainly make a point of doing so when next at the exhibition; the performance is well worth listening to.

"Power" or "Energy"?

In a letter which we reprint in another column, an esteemed correspondent supports the common misuse of the term "power" when referring in a general sense to "energy." He rightly states that the term has been sanctioned by custom, and in this particular we agree with his comments, but at the same time we feel that there is a growing tendency thus to mutilate our mother tongue, which should be checked as far as possible in the interests of a pure spoken race. In these days of communal education we hear little enough of King's English, which is too often looked upon as academic and bad form. *We* are sufficiently old-fashioned, however, to retain a taste for the language of our birthright, and we maintain that this is a worthy opinion in these cosmopolitan days when the presence of so many foreigners in our midst tends to disguise still further the original English as she was spoken.

N.A.S.E. Scholarships.

Hearty congratulations to the National Association of Supervising Electricians upon the second annual competition now in progress for three scholarships, each worth £20. This is a praiseworthy movement in aid of the better education of a very painstaking class of worker, and proves that this representative association has at heart the best interests of its members and their sons. I sincerely trust that these scholarships will long continue to be an annual inducement to youths to improve their knowledge and experience of electrical work.

E.D.A.

In spite of the handicap of the high-priced unit, the E.D.A. still actively wages its campaign in favour of electrical service. It consistently issues fresh and attractive literature appealing to the popular taste and calculated to win over many converts to the use of electrical energy for domestic purposes. Several excellent specimens are before me as I write, prepared principally in support of the energetic campaign which is being carried on in the Palace of Engineering at Wembley, and examples of which are obtainable at the "Electricity in Service" stands.

An Instructive Paper.

All readers interested in small electrical machinery, dynamos and motors will find much to intrigue them in a paper presented to the I.E.E. by Edward Hughes, B.Sc. It deals with the Rise and Distribution of Temperature in Small Electrical Machines, and is highly mathematical. It is too lengthy to permit of reproduction in our columns, but contains a mass of useful and instructive information which many readers would doubtless find of great value and assistance in dealing with this class of small power plant. Another interesting communication which has reached us, and is similarly unsuitable for full publication, deals with the manufacture of bricks from boiler ash and clinker, an attractive by-product for the enterprising central station engineer who has difficulty in disposing of his boiler-house refuse, especially in these days of housing shortage.

The Flying Scotsman.

Visitors to the Palace of Engineering are drawing certain inferences from the proximity of a bar to that interesting railway exhibit, "The Flying Scotsman." It has been suggested that the Scotsman is flying because it was his turn to pay for drinks; another libel on the chiel frae Glesgae.

Story of a Mouse's Sad End.

This is the story of another mouse which has perished by getting too friendly with H.T. But, unlike the other mice, this one elected to have its last adventure in so lowly a place as a colliery engine-room and incidentally knock-off one machine. More ambitious mice, you know, generally shut down a town's supply. The happening was one of the great events of the engine-room man's life. He was, as they say, "full of it." When I strayed in one day on business and was inspecting the iron-clad switchgear (which was installed behind a railing) the engine-room man seized the opportunity and approached. He carried his mainstay—an oily rag, which, I noticed, he used as handkerchief, scarf and machine wiper with the utmost impartiality. By way of an opening, he thoughtfully passed the oily rag along the railing. I had just been leaning on that railing, so I felt the back of my coat. My fears were justified!

"You see that new ammeter?" the engine-room man said. I saw it. "Well," he went on, wiping his hands on the rag, "a little mouse blew the old one out." He paused, and watched with satisfaction the incredulous look that appeared on my face. "Ay," he said, "a little mousie got on the ternamals in yonder. Bang! Off went the ammeter across the engine-room." "Phew!" I said. (That was expected of me, so I gave it.) "Yes," he went on, "I've got it here"—and he produced a piece of much-cracked mica and the ring from the instrument's cover. I asked whether he had the mouse. He looked hard at me, then shook his head. It seemed there wasn't much mousie left on the "ternamals." "What's more," he said, "we'd only just finished having our *bait*, sittin' on these railings." "Good heavens!" I said. "What a bang there was," he observed. I nodded. "You could hear it half a mile away," he added. "My word!" I replied, edging towards the door. "Even the manager heard it," said he. "Well, I must be off," I pointed out, in a final sort of way. "Ay, ay," replied the engine-room man, passing the rag round his chin. "But that little mousie didn't ought to have got on the ternamals, did it?" "No," I agreed, striding away. Certainly that little mousie didn't ought to have done so!

Elektron.

"**The Motor Ship**."—Our contemporary has just issued a remarkably well printed circular setting forth the progress of the paper and the success which it has achieved in the way of circulation and development in all parts of the world. It is evident that the rapid growth of the new motor ship industry is being well supported by the leading journals dealing with the subject. The front cover has a charming illustration in colour of one of the latest liners. It is really a work of art, and, as such, is worth keeping.

OUR OVERSEAS GUESTS.

With their usual hospitality, the President and Council of the Institution of Electrical Engineers have had much pleasure in entertaining a large number of electrical engineers from our Colonies and abroad who have been visiting London in connection with the World Power Conference, the Kelvin Centenary and other allied functions. The programme started on Thursday, July 10, with a reception at the I.E.E. building, when the President, Dr. Alexander Russell, delivered an address of welcome, to which a suitable reply was given by Mr. Fraser S. Keith, the secretary of the Engineering Institute of Canada, after which an adjournment was made to the Hotel Cecil for luncheon. This was a very happy and informal affair, at which Mr. L. B. Atkinson, Past-President, proposed "Our Guests" in one of his inimitable speeches, and Mr. J. W. Lieb, Past-President, Am.Inst.E.E., replied very effectively. The next move was to the Institution of Civil Engineers at Great George Street to see the Kelvin Centenary Medal presented to Professor Elihu Thomson (U.S.A.) by Sir Charles L. Morgan, C.B.E. (President, Inst.C.E.).

On receiving the medal, Professor Thomson, in thanking the chairman for the presentation, said it was particularly gratifying to him to receive it, as it testified to a broad appreciation of scientific effort and of engineering efforts of which his own career was accepted merely as an example, for he could not but regard it as also a tribute to the labour of his fellows in America and elsewhere, not only those who were and have been definitely associated as loyal helpers, but in general, to the earnest ones in those studies bearing relation to the subjects in which Kelvin himself dearly loved to work, and whose labours were so fruitful and versatile. They liked to think of him as an example of what a man great in science and engineering should be. After contrasting the standards of achievement in engineering and the other professions, he referred to Kelvin as his ideal, an influence and example not to be estimated, lovable as a man, unequalled as a scientific exponent, and their earliest and greatest electrical engineer. It would thus be seen how deeply he appreciated and treasured the honour now bestowed on him (the speaker) as a follower of Kelvin.

Sir Richard T. Glazebrook having taken the chair and received addresses from British and foreign delegates, Sir Joseph J. Thomson delivered the Kelvin Oration, in the course of which he said Lord Kelvin's services to science were not confined to his own discoveries and inventions. For more than half a century his personality and enthusiasm initiated and stimulated the work of others. When he visited a laboratory he would talk to each of the workers about his experiments. His kindness and obvious interest in what they were doing stimulated and encouraged them to renewed efforts. They were better physicists after his visits than they were before because they had a new interest and a greater belief in the importance of their work. These qualities were nowhere more conspicuous than at the meetings of Section A of the British Association. He would stay, generally accompanied by Lady Kelvin, from the beginning to the end of the meetings, always saying something suggestive and ingenious on nearly every paper, filling the meeting with life and interest, and inspiring and encouraging the younger men in a way no one else could approach. They were that day commemorating the memory of one who was an outstanding figure in the union of theory and practice, who, in his own way and by methods of his own, made vast and important additions to our knowledge, and who had left an example of unremitting and untiring devotion to a great ideal.

After the lecture many of the large gathering inspected the exhibition of instruments and records of Lord Kelvin's work on view in the library of the Institution.

The daytime of Friday the 11th was devoted to a visit to the British Empire Exhibition at Wembley, for which motor coaches were at the disposal of the guests at 10 a.m., and in the evening the Kelvin Centenary banquet was held at the Connaught Rooms, when a distinguished and international gathering of over three hundred engineers and scientists, under the chairmanship of the Rt. Hon. the Earl of Balfour, K.G., O.M., F.R.S., listened with keen interest and pleasure to his splendid eulogy of the great man whom they had gathered to honour, the striking sentence that: "Kelvin was not merely a great man of science. He was a great inventor, who had the instinctive knowledge of the way in which physical discovery led to industrial progress," being received with enthusiastic applause. The toast, "In Memoriam: Kelvin," was pledged in profound silence, after which Sir Richard Glazebrook proposed "The Delegates to the Kelvin Centenary," and Professors Elihu Thomson and Luigi Lombardi responded, while the toast of "The Chairman" was very ably put by Dr. A. E. Kennelly, Professor of Electrical Engineering at Harvard University, who said that the Earl of Balfour was deeply revered in America, a sentiment which was most cordially endorsed by all present, and for which Lord Balfour expressed his grateful thanks.

On Saturday our guests visited Cambridge, and were received in the Lecture Theatre of the Cavendish Laboratory by the Vice-Chancellor, Rev. E. C. Pearce, D.D., who gave them a most cordial welcome, and then short accounts of the history of the laboratory were given by Sir J. J. Thomson, O.M., F.R.S., Master of Trinity, and by the Cavendish Professor of Experimental Physics, Sir Ernest Rutherford, F.R.S., for which courteous thanks were given by Dr. Russell. The party then divided into sections, and were shown over the laboratory by various kindly lecturers and assistants, who gave willing explanations of the research work being carried out in the different rooms. Then followed an enjoyable luncheon in the Hall of Trinity College, with Sir J. J. Thomson in the chair, and the painting of Henry VIII. gazing down on us most amiably, after which the Vice-Chancellor delivered a further most interesting and instructive address on the University and its various colleges. In the afternoon the party divided, some inspecting the laboratories and others visiting various places of interest in the town, but all meeting in the Fitzwilliam Museum at 5 p.m. to take tea with the Vice-Chancellor.

For Sunday morning seats were reserved at Westminster Abbey and St. Paul's Cathedral, while Sunday afternoon found a fair sprinkling of the guests enjoying the sunshine at the Zoological Gardens, for which a certain number of tickets were available.

Monday saw another strenuous but most enjoyable day devoted to a visit to Birmingham, one party going over the University and its laboratories, and another inspecting Mr. Chattock's new plant at the great Nechells central station of the Birmingham Corporation, which is showing such splendid results, much to the satisfaction of Messrs. Sparks and Partners, the consulting engineers for the plant now running. At 1.15 the Lord Mayor of Birmingham (Alderman T. O. Williams, J.P.), and the Lady Mayoress acted as hosts at luncheon at the Grand Hotel, where our overseas guests were most heartily welcomed. In the afternoon motor coaches conveyed them all to Stratford-on-Avon, where a halt was made for tea and the customary visits to Shakespeare's birthplace, Ann Hathaway's cottage, Holy Trinity Church, etc., and then the party went on to Leamington Spa, returning to Euston by the Dining Car Express, on which they were entertained to dinner by the L.M. and S. Railway Company.

Tuesday wound up a very successful series of visits in the way of a motor drive to Chiswick at the invitation of Lord Ashfield, in order to inspect the great repair and overhaul works of the London General Omnibus Company, and after a luncheon presided over by Field-Marshal Sir William Robertson, in the unfortunate absence of Lord Ashfield, the journey was resumed to Windsor Castle, where the party were received on behalf of their Majesties by Dr. Lionel H. Cust, M.V.O., and the State apartments visited, much to the pleasure and interest of all present Then followed tea at the White Hart Hotel, and after the return to town there was a conversazione at the Institution of Civil Engineers, which brought the festivities to a close. It only remains to add that the arrangements throughout worked without a hitch, and reflect great credit on the way in which they had been organised by Mr. Rowell, the secretary of our Institution, and his courteous assistant, Mr. Rayner. This was the unanimous opinion of our own colonial members as well as our American visitors and their wives, and the same remarks apply to Mr. D. N. Dunlop and the way in which he organised the Kelvin Centenary functions. They were well done, and the result has been eminently satisfactory.

Correspondence.

"POWER" OR "ENERGY"?

To the Editor of ELECTRICITY.

DEAR SIR,—In your note under the heading of "Current Topics," on July 11, you criticise the use of the word *power* as used in the name of the World Power Conference. I think the use of the word in this connection must be regarded as sanctioned by custom. The definitions of *force*, *work*, *energy*, *power*, *stress*, *strain*. and so on, from an engineering point of view differ somewhat from the meanings of the same words as used in ordinary conversation.

"Bid Stanley come with his power," said Richard III. He might have said *force*, but *energy* would sound strange. An army is called a force, but in engineering a *force* does not come into existence until it is applied to something, when it may or may not do *work*, depending on whether the object to which it applied moves or not. From an engineering point of view, if you hold half a hundredweight at arm's length for a quarter of an hour, you do no work; but from the human standpoint you will be in much need of a rest. It might be said that you would *strain* your arm, but in engineering language you would have *stressed* it; *strain* would only have occurred if your arm broke, or altered its shape under the stress.

What was considered at the recent Conference, I take it, was the use of available sources of energy for power purposes; the term World Power Conference is a short and generally understood method of saying so. Would anyone talk of "the great Energies of Europe"?

Yours faithfully,
A. J. CRIDGE.

July 16, 1924.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 184.

I would appreciate details of a three-phase 6,600-volt transmission system (overhead). What is the function of the guard wire? What type of earth plates are used? Is every lattice-type pole earthed, etc.?—"FREQUENCY."

QUESTION NO. 185.

I understand that every central station has a potentiometer for calibrating instruments. What are the advantages of this instrument for this purpose as compared with standard instruments?—"JUNIOR-SHIFT."

(Replies to Questions Nos. 184 and 185 must be received not later than July 26, 1924.)

Quotations Wanted.—The N.S.W. Public Works Dept., Sydney, are calling for tenders for the supply of insulators for a pressure of 66,000 volts for the Barren Jack hydro-electric development scheme.——The State Electricity Supply Works at Montevideo invite tenders for the supply of white varnished insulators and the necessary iron brackets or bolts.——The Argentine National Sanitation Works Dept. at Buenos Aires are calling for tenders for the supply and delivery of machinery for a hydro-electric station to be installed in the town of Mendoza. The plant required includes horizontal turbines, 3-phase a.c. generators, switchboard, pipes, etc., and spares.——The Public Works Dept. at Wellington, New Zealand, are calling for tenders for the supply of transformers for the Mangahao Power Scheme. Also for 11,000-volt switchgear and metering equipment for the same scheme.——The P.M.G.'s Dept., Sydney, N.S.W., are calling for tenders for motor generator sets for the Telephone Exchange.——The N.S.W. Govt. Rys. and Tramways Dept., Sydney, are calling for tenders for a 20,000 kw. turbo alternator. Specifications, etc., from the D.O.T. (Room 52), 35, Old Queen Street, London, S.W.1.

Reviews of Books, &c.

[Books noticed in this column will be sent from ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

THREE NEW B.E.S.A. SPECIFICATIONS.—The British Engineering Standards Association has recently issued a specification covering two grades of silver solder (Publicn. No. 206—1924), the silver content in grade A being between 60 and 62 per cent. and in grade B between 42 and 44 per cent. Two specifications for special brasses, one for ingots for castings (Publicn. No. 207—1924), and the other for actual castings (Publicn. No. 208—1924), have also been published. These two specifications cover the same five grades of materials which are classified according to their minimum tensile strength, ranging from 28 to 45 tons per square inch. The copper content of each class is specified, a maximum total percentage only being given for metals other than copper and zinc, which are tin, iron, manganese, aluminium and nickel. Copies of the specifications may be obtained from the B.E.S.A. Publications Department, 28, Victoria St., Westminster, S.W.1 (price 1s. 2d. each, post free), or from ELECTRICITY Office.

FACTORY COSTING. By H. H. Emsley, B.Sc. Cr. 8vo, 253 pp., illustrated. (Constable, 7s. net.)—In this book the author, who is the associate head of the department of optical engineering at the Northampton Polytechnic Institute, London, has set down in print the substance of a course of lectures on "Costing," given by him to students who were training to become engineers, scientific instrument makers, etc., and it can be welcomed as an eminently sound and logical treatise on a subject in which it is essential manufacturing engineers and electricians should have a much better grounding than is, we fear, generally the case. Mr. Emsley appeals more particularly to the small manufacturer, and it is just that class of man who does really need educating to a correct view of his costing problems, as otherwise he is all too prone to try and cut things too fine, with a result which leads ultimately to bankruptcy, or, what is almost worse, the production of cheap and inefficient goods. This is a complaint from which the electrical industry has suffered far too much, and if this book helps to reduce it, as indeed it should, then the author will have conferred a benefit for which we shall all be most devoutly thankful. Not only does the book appeal to the manufacturer, it should be studied most carefully by every intelligent working mechanic who takes an interest in his job, and the way or ways in which he can increase his wages, for which purpose a copy ought to be purchased by the branch or local secretary of the great trade unions in every town, so that members can borrow it if necessary. Finally the appendix contains various tables and standards which are certain to be useful for reference purposes, and the exercises which are given at the ends of various chapters will afford sound practice for all who take the book seriously to heart.

TELEPHONE CIRCUIT DIAGRAMS. By John M. Heath, 1st-Lieut., Signal Corps, U.S. Army. (McGraw-Hill, 12s. 6d. net.)—An excellent and clearly printed series of comprehensive circuit diagrams with accompanying explanations in text. This is just the thing for telephone students and engineers who are entering on the initial stages of a study of the complex subject of telephony.

Automatic telephony is not touched upon, the circuits referring only to the various phases of manual telephones and switching, including local battery telephones, switchboards and party lines, and common battery telephones, switchboards and party lines.

The diagrams, which are the main feature of the book, are particularly clear and well printed; the book is an ideal pocket companion for the telephone inspector and student.

Various Items.

Wanted.—Can any reader furnish us with technical details of the "Klydo" electric signs? Another reader has asked us if we can describe the system.

Wages Receipts.—Under the new Finance Act, it is not necessary to give a stamped receipt for weekly or monthly wages or salary. Hitherto this has been a disputed point.

Summer Holidays, 1924.—The works of Alley and MacLellan, Ltd., Worcester, will be closed from August 2 until August 14, both dates inclusive, and no material will be received during that period.

Worth Reading.—The *Northampton Gazette* for July, the official publication of past and present students of the Northampton Engineering College, is a most readable and withal humorous production. Apart from the usual news items of interest to students only, there are interesting extracts from a diary of a visit to Vienna; an Ode to the Modern Blacksmith; Science and Engineering in Ancient Times; and the third and last chapter of the Book of Lek-toe-tek, the Scribe.

A New B.E.X. Guide.—A new edition of the official guide to the British Empire Exhibition has just recently been published by the authorities. It contains a lot of additional information which could not be included in the original guide, and is, therefore, a great improvement on the copies which have hitherto been on sale. It should most certainly be in the possession of every exhibitor, quite apart from the copies which are being sold to the general public. Price 1s. 2d. post free from this office.

The Business Features of Wembley.—"An Investor's Tour of the Empire," compiled by the *Investor's Chronicle*, price 1s., is actually an excellent, correct, and detailed guide to the B.E. Exhibition. It is just the right book of reference for the business visitor who wishes to know the whereabouts and principal items of interest on certain stands in which he is likely to be interested. It covers the ground rather more thoroughly than the official guides published for the popular visitor, and should have a ready sale.

Haymaking at Wembley.—During the current week it is anticipated that on the electro-farming exhibit of the British Electrical Development Association, arranged by Mr. Borlase Matthews, of the Electric Farm at Great Felcourt, East Grinstead, an actual demonstration of making hay by electric power, and independently of sunshine, will be in operation. It is to be noted particularly that the process is one of really *curing*, and not merely drying. The hay may be stacked green, or even wet, being cured in the stack by powerful blasts of air driven through it by electrically operated fans. Readers who are visiting the Exhibition should make a point of witnessing the demonstration.

World Power Conference.—The Transactions of the great World Power Conference are to be reprinted in book form by Messrs. Percy Lund, Humphries and Co., Ltd., of 3, Amen Corner, London, E.C.4, and should be ready about December next. They will represent four volumes, in all about 5,500 pages, royal 8vo, and the price of the set, if ordered before September next, is £10. It is to be hoped that sufficient support will be forthcoming to justify the publication of these transactions, which will be profusely illustrated with diagrams, graphs, plans, reproductions of photographs, etc. We can cordially commend this great book to all engineering firms, and hope that the publishers will be well supported with orders.

Northampton Institute.—The vacant principalship of the Northampton Polytechnic Institute, Clerkenwell, caused by the tragic death of Dr. R. Mullineux Walmsley in June, has been filled (subject to the approval of the L.C.C.) by the appointment of Mr. S. C. Laws, M.A. (Cantab.), M.Sc. (Lond.), Principal of the Wigan Mining and Technical College for the past nine years. Mr. Laws was educated at University College, Nottingham, and St. John's College, Cambridge, where he attended as an 1851 research scholar and was admitted as an advanced student. He worked at Cambridge at the Cavendish Laboratory under Sir J. J. Thomson, and received the special distinction of an extension of his 1851 scholarship for a third year, the University of Cambridge awarding him the certificate for distinguished research. He was awarded the M.Sc. by the University of London for experimental research undertaken while at Blackburn.

Trade Notes.

The fifteenth edition of their Wire and Cable Catalogue, Section W (1), just to hand from **The General Electric Co., Ltd.**, is undoubtedly the most comprehensive list of this material we have yet seen. It contains full data concerning every type of Pirelli-General V.I.R. insulated wires and cables of both Association and non-Association grades, tough rubber cables and flexible, aerial cables, flexible cords for all services, bell and telephone wires, signalling wires, etc. The information is set out in a clear manner, and is boldly printed on good paper. For ease of reference the catalogue is divided into five sections, in addition to the introductory pages, upon which are given views of the Pirelli-General Cable Works at Southampton, and illustrations of various typical cables. Thus, Section I. is devoted to a number of extremely useful tables containing wiring data, comparison tables for wire, conversion tables, useful formulæ and a price calculator. Section II. contains particulars and prices of Association grade cables and a facsimile of the label of the C.M.A. (of which the G.E.C. are members). The catalogue is now being distributed, and we advise every engineer and installation contractor to obtain a copy, for he will undoubtedly find it of the greatest possible service.

Messrs. Bostock and Bramley, power transmission engineers, state that Captain Bramley-Moore is leaving this country to reside in the United States, and, in order to effect a closer working with Messrs. Joshua Buckton and Co., Ltd., with whom the firm are in association, the business address is being transferred from Netherton, and is in future Dewsbury Road, Leeds. They report a continued rapid expansion in their business of power transmission engineering in connection with enveloping worm gear and concentric speed transformers.

Sample Pair Sent on Approval for 8/6
Made of Pure Para Rubber, soft and durable and unaffected by climatic conditions
DAVID MOSELEY & SONS, Limited,
ARDWICK, MANCHESTER.
MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

AUGUST 1, 1924

CONTENTS.

	PAGE
A.C. Power Tariffs	395
Progress with Pulverised Fuel	396
G.E.C. Witton Works Outing	397
Telegraphy	397
Hydro-Electric Power Plant Design	398
Current Topics	401
The Written Application—and Its Chances of Success	403
The Marryat and Scott Lift at Wembley	404
The Australian Electrical Wiring Rules	404
Questions and Answers by Practical Men	404
Reviews of Books	405
The Electrical Kitchen for Private Houses	405
Various Items	406

A.C. POWER TARIFFS.

By G. W. STUBBINGS, B.Sc.

The prevailing principle underlying the fixing of charges for electricity supply seems to be that the charge per unit made by the supply authority should be based upon the cost of generation and distribution to the consumer. It is by no means certain that this principle is sound, considered from either an economic or an ethical standpoint, and it would be well if a critical inquiry into the correct principles underlying the framing of electricity tariffs were undertaken by economists.

The total cost of supplying a consumer is made up of two parts, the one being the cost incurred by the undertaking in being in a position to meet his demand, whether this demand is actually made or not, and the other the extra cost incurred in actually supplying the units he uses. The first part obviously depends upon the maximum demand of the consumer, but is not the same fraction of the total charges of this nature, as the consumer's maximum is that of the total maximum demand. This arises from the fact that consumers' maxima do not occur simultaneously. The ratio of the sum of the consumers' maxima to the station maximum load is known as the diversity factor. It is customary to divide consumers into various classes according to their use of electricity, and it is then considered that the diversity factor of each class can be estimated with a fair degree of accuracy. The proportion of the total standing charges borne by a consumer depends then upon the maximum load divided by the diversity factor of the class to which he belongs. The total standing charges are usually taken as including not only capital charges, but also a proportion of the fuel costs and wages and salaries, the "running" costs comprising those not included in the standing charges. It is thus seen that the charge to any particular consumer depends upon his load factor, diversity factor, and the number of units consumed. As the second of these factors cannot be continuously measured it has to be estimated or assumed for the particular group to which the consumer belongs. Two methods of charging now remain. First, the two-part tariff, consisting of a quarterly or annual charge based upon the maximum load plus a certain rate per unit, the maximum load either being directly measured as, with tariffs for power supply, or being based upon consuming devices installed, rateable value, and so forth, as with the now usual domestic tariffs. Secondly, the load factor as well as the diversity factor may be assumed, in which case a rate per unit can be fixed which covers the standing as well as the running charge. This is the basis of the flat rate, and explains the difference in the charges for electricity according to the uses to which it is put. The high price of lighting units being due to the low diversity and load factors, and the low price of power units being due to the improved load factor. The abnormally low price of heating and cooking units is said to be justified by the fact that although the load factor of this load is exceedingly small, its diversity factor is very high. The writer does not believe that this forms a sufficient justification for the usual rates, and is of the opinion that the existing practice in this respect cannot altogether be upheld by the "cost of production" theory of charging.

We have hitherto assumed that the standing charges in respect of a consumer are proportional to his maximum demand, and have ignored the effect of power factor. Inquiring into the nature of this effect it is easily seen that as all electrical machinery is rated on a current-carrying basis, the increased current necessary per kw. with a low-power factor will necessitate a correspondingly greater plant capacity on the electrical side. In short, the capital charges in respect of the electrical plant, generating, transmitting, transforming will be proportional to the kilo-volt amperes in the maximum demand. The capital charges on the steam-raising plant and the prime mover will depend upon the kw. of demand only. Again, since the electrical apparatus required per k.v.a. at the required power factor may be assumed to be so proportioned that the normal percentage resistance drop occurs within it, this drop being associated with a larger current, will represent a larger percentage loss varying as the reciprocal power factor. It is, therefore, seen that it is a matter of no small difficulty so to frame a tariff as will give, under varying conditions of diversity, load and power factors, the true cost of production. There are in use two approximate methods of charging which purport to be based on the cost of production theory.

The first of these is the ordinary two-part tariff of a quarterly sum plus a charge per unit, the quarterly charge being based, however, on the k.v.a. in the maximum demand. This tariff imposes increased standing charges for boiler and turbine plant for low-power factor, but ignores the greater loss in transmission. We may see the sort of compensation obtained by this compromise by considering a tariff of £2 per qr. per k.v.a. plus 1d. per unit. We will assume that one quarter of the standing charges are appropriate to the non-electrical plant and are, therefore, invariable. We will also assume that at unity power factor the total copper losses are 16 per cent., so that at .5 power factor these will be increased to 32 per cent. At unity power factor 1/0.84 units have to be generated to deliver 1 unit to the consumer's terminals, and at 0.5 p.f. 1/0.68 have to be generated. The increase in the cost of generation owing to increase of losses is therefore about 0.84/0.68 – 1, or about 25 per cent.

Consider now conditions corresponding to 20 per cent. load factor and unity power factor. The standing charge per k.v.a. per quarter is 480d., and the consumption in units per kw. is 20 per cent of 13 × 168 units, the cost at 1d. per unit being 436d. The total cost is therefore 916d., giving an average of 2.1d. per unit. At 0.5 power factor the k.v.a. of maximum demand will be doubled per kw., and the cost per unit will be 3.2d. To determine the true cost of production at 0.5 power factor we note that one quarter of the standing charge will be unaffected, and this charge will be 840d. per kw. The cost per unit will, however, be increased by 25 per cent. owing to increased losses, and the running charge per kw. will be 545d. The total cost per kw. per qr. is 1,385d., giving an overall rate of 3.2d. per unit. In this case the compensation is nearly exact. Working out a comparison for a 50 per cent. load factor we find that the k.v.a. maximum demand tariff gives an increase in the price per unit due to a 0.5 power factor of 30 per cent., whilst the cost of production is increased 40 per cent., the tariff in this case favouring the consumer. It may, however, be taken that the tariff is in every way as good a one as can be devised when the maximum demand system is desired.

There is another method of adjusting the charge per unit to the power factor of the load, which does not require the maximum demand to be metered. This method is based upon the fact that low-power factor requires additional current to transmit each kw. of power, and this additional current, although wattless, yet costs a definite amount to generate and transmit. If i be the current required per kw. at unity power factor, then generally the current per kw. will be $i/\cos\phi$, and the extra current will be $i\left(\frac{1}{\cos\phi} - 1\right)$.

If the cost of supplying this current per k.v.a. is m times the cost of a kw. hr. at unity power factor (m being a proper fraction), the total cost per unit at any power factor will be proportional to

$$i + mi\left(\frac{1}{\cos\phi} - 1\right) \text{ or to } (1 - m)\,i + \frac{mi}{\cos\phi}$$

From this it appears that the consumer should be charged for a number of units equal to $(1 - m)$ of the actual units, plus m of the k.v.a. hours he has used. The sum of these quantities can either be directly metered, as was shown by Dr. Arno, the originator of the system, or from the formula a schedule can be drawn up giving the actual price per unit at various power factors.

A usual figure for the factor m is $\frac{1}{3}$. We may calculate this for the standing and running charges mentioned above for a load factor of 25 per cent., and by charging the "extra" k.v.a. hours with $\frac{3}{4}$ of the standing charges only. The number of k.v.a hours per k.v.a. of maximum demand will be $\frac{1}{4} \times 13 \times 168 = 546$, and the charge will be 360d., corresponding to 0.66d. per k.v.a. hour. The price per unit at unity power factor for these conditions will be 1.9d., giving a figure per m of just over $\frac{1}{3}$.

A modified tariff has been suggested by Mr. Carrothers which imposes the usual charge per unit, plus a lesser charge per k.v.a. hour of actual wattless current (not extra current). The charge will then be of the form $P(1 + n \tan\phi)$, and it is possible to choose a value for n, so that the curve giving the variation of price and power factor is practically coincident with the Arno method of charging over a considerable range of power factors. The Carrothers method has the great advantage that the metering is quite simple and that no complicated calculations are required to obtain the amount chargeable to the consumer, and on these grounds the method is deserving of extensive use.

Nothing has been said as to the additional metering instruments required for the tariffs taking account of power factor. This matter is one of great importance, as a complicated system, besides introducing serious risks of error, may raise doubts in the mind of the consumer as to the equity of the system by which he is charged. The writer hopes in a future article to give a brief and critical résumé of the special instruments that are used in connection with these tariffs.

PROGRESS WITH PULVERISED FUEL.

(From a Correspondent.)

One of the most remarkable aspects of pulverised fuel firing is its extreme flexibility, not only in the ordinary sense of the word as regards starting up or shutting down the flame in a few minutes and giving enormous overloads, but also from the point of view of adaptation to suit individual circumstances and the possibilities of future developments in technique. Thus, for example, for the first time in the firing of boilers there is no limit to the size of the individual unit as far as the furnace is concerned. All that is necessary is simply to enlarge the size of the combustion chamber and add more burners. The largest single boiler in the world to-day is 32,750 square feet heating surface, at the Alleghenny Steam Heating Co., of Pittsburg, the normal evaporation being about 300,000 lb. of water per hour, without superheaters or economisers, fired with "Lopulco" pulverised fuel. It is interesting to note that the furnace is designed to give an evaporation in the boiler of anything from 40,000 lb. to 450,000 lb. of steam per hour, that is a ratio of 11 : 1, a very striking indication of the flexibility of pulverised fuel, both as regards evaporation and size of boilers.

One of the most remarkable developments, however, is the principle of the completely automatic steam boiler plant, and on this subject Mr. W. J. Cotterell, who has just returned from a tour in the United States on behalf of Messrs. The Underfeed Stoker Co., Ltd., of London, has some rather interesting comments to make, as he has made a detailed inspection of the working of this principle on a number of plants, particularly the Union Electric Light station at Cahokia (St. Louis), and that of the Cleveland Electric Illum. Co.

The general design of the automatic control being adopted is that as the actual steam flow varies, the speed of the pulverised coal feeding screws and the height of the air damper is altered mechanically in conjunction with the steam flow meters, thus varying both the coal and the air supply to the furnace to suit the different steam demands of the boilers, the combustion being kept continually at a maximum efficiency as the relative amounts of air and fuel remain correct irrespective of the rate of combustion.

The mechanism is stated to be of the most robust construction, and to work extremely well, there being also a special device so that when the maximum air supply is attained no more speed can be put on the fuel feeders, and an alarm signal on the control board shows that the boiler is working at the highest capacity whilst hand control can be resorted to at any time by merely turning a handle.

Mr. Cotterell also states that at the huge Ford plant at River Rouge, Detroit, the second four boilers of 26,400 square feet heating surface, on 70 per cent. blast furnace gas and 30 per cent. pulverised coal, are now being put into service, and that the new Cahokia plant at St. Louis is working extremely well, the results obtained being expected to equal those of Lakeside, Milwaukee. The first 60,000 kw. at Cahokia has been in operation on the "Lopulco" system of pulverised fuel for six months, and it was the first plant to instal the "Wood" vertical gravity waste heat coal driers, using the chimney gases only for drying, and a second 65,000 kw. is now being completed, the station itself being designed for 300,000 kw., and will, therefore, be one of the largest in the world.

G.E.C. WITTON WORKS OUTING.

On Saturday, the 12th inst., the staff and workpeople of The General Electric Co., Ltd., at Witton Works, held their annual outing, and in accordance with the prevailing fashion, spent the day at the British Empire Exhibition at Wembley. The party, over 2,000 strong, travelled from Birmingham by special trains and arrived at Wembley at 9.30 a.m. A printed book of instructions giving suggested itineraries of the exhibition was handed to each member but, very wisely, no attempt was made to organise a stereotyped programme for all. The only exceptions to this arrangement were the lunch at 11.30, one half of the party being catered for at the Stadium Restaurant and the other at the Regent Café, and a rendezvous at the G.E.C. Pavilion at 1 o'clock where the photograph reproduced herewith was taken.

Accompanying the party were Dr. A. H. Railing, Dr. C. C. Garrard, Dr. R. Orsettich, Mr. W. H. Heaton, Mr. J. Morris, and other officials of the Company. The remainder of the day was spent most enjoyably, the various members of the party suiting their own fancies. A return was made to Witton at a late hour after a strenuous but thoroughly enjoyable day.

It was no mean task to pilot a gathering of 2,000 from Birmingham to London and back and through the Exhibition, and the fact that the party saw all they came to see and returned intact, speaks volumes for those responsible for the detail arrangement of this wonderful outing.

TELEGRAPHY.*

Being solutions to the questions set at the Grade I. examination in Telegraphy held by the City and Guilds of London Institute, on April 30, 1924.

(*Continued from page 386.*)

Q.—A wire of a given length and of 4 mils. diameter has a resistance of 100 ohms. What is the resistance of a wire of the same length and same material but of 2 mils. diameter? If a current is passed through these two wires when they are joined in parallel, which will get the hotter, and why?

A.—The resistance of any wire varies directly as its length and inversely as the square of its diameter. Let

R_1 be the resistance of the first wire,
R_2 ,, ,, ,, second wire,
l_1 ,, length ,, first wire,
l_2 ,, ,, ,, second wire,
d_1 ,, diameter ,, first wire,
d_2 ,, ,, ,, second wire,

then

$$R_1 \propto \frac{l_1}{d_1^2}$$

and

$$R_2 \propto \frac{l_2}{d_2^2}$$

By division—

$$\frac{R_1}{R_2} = \frac{l_1 \times d_2^2}{l_2 \times d_1^2}$$

But $l_1 = l_2$, therefore

$$\frac{R_1}{R_2} = \frac{d_2^2}{d_1^2}$$

i.e.,

$$R_2 = \frac{R_1 d_1^2}{d_2^2}$$

Substituting the given numerical values—

$$R_2 = \frac{100 \times 4 \times 4}{2 \times 2}$$
$$= 400 \text{ ohms.}$$

The heat generated in a conductor varies as the product of the square of the current and the resistance, i.e.,

$$H \propto I^2 R.$$

In the present case the current will divide between the two paths in inverse proportion to their separate resistances, i.e., since the resistances are 100 and 400 ohms respectively, 4 parts of the current will flow through the 100-ohm circuit and one part through the 400-ohm circuit. The heat generated will, therefore, be in the proportion—

---

* Books recommended are:—*Questions and Solutions in Telegraphy and Telephony, Grade I.*, by Few (Rentell, 5s. 10d., post free), and *The Telegraphists' Guide*, by Bell and Wilson (Rentell, 3s. 10d., post free).

$$H_1 : H_2 : : 4^2 \times 100 : 1^2 \times 400$$

i.e.,

$$H_1 : H_2 : : 4 : 1$$

Hence the 100-ohm wire will get the hotter because the current flowing in the wire is four times greater than that flowing in the 400-ohm wire.

(To be continued.)

HYDRO-ELECTRIC POWER-PLANT DESIGN.

There are many power plants and possible sites for plants where the supply of water is very irregular, and where, owing to the nature of the surrounding country, it is impossible to provide sufficient storage for the utilisation of all the water flowing in the stream, says Mr. J. A. Sirnit, of the American Society of Mechanical Engineers.

In many hydraulic power plants, now in operation or proposed, there is, or will be, a great loss of power annually, due to the fact that during flood conditions, when water is being wasted over the spill-way, the level of the water in the tail race at the outlets of the draft tubes leading from the turbines is raised, thus reducing the head on the turbines, and in turn their capacity and the output of the power plant. There are many notable examples of these conditions, and in some cases reduction in effective head on the turbines becomes so great at times as to completely shut down the power plant. The Hales Bar plant on the Tennessee River is an example of where these conditions occur during the spring floods.

In many cases of proposed developments, engineers have hesitated in recommending the carrying out of the development on account of backwater conditions in the tail race, which can be foreseen and predicted very closely. The proposed development at the Great Falls on the Potomac, which has been under discussion for many years, represents an example.

Engineers for many years have wrestled with this problem, and have tried to overcome this difficulty by installing a greater number of generating units where it was possible to do so to compensate for the loss in capacity of each unit; of course, such a procedure necessarily makes the installation more expensive, with the resulting increase of production costs. Attempts have also been made to counteract this loss in head by admitting water into the draft tube through jets at a relatively high velocity which, by accelerating the velocity of the combined turbine discharge and jet water through the draft tube, produce a negative head which is added to the head on the turbine. A number of variations in the place and manner of introducing this jet into the draft tube have been tried, and results published. But the results have not been entirely satisfactory.

The most logical and simplest way to maintain the normal head on the water wheel, and thereby the full capacity of the plant during flood periods, is to remove the high tail water from the discharge opening, and credit is due to O. G. Thurlow, chief engineer of the Alabama Power Company, who conceived the idea of utilising the waste water to accomplish this fact, thereby successfully solving the problem. The development of this conception resulted in what is now known as the Thurlow backwater suppressor.

THE THURLOW BACKWATER SUPPRESSOR.

It is a well-known phenomenon that water flowing over a masonry dam having a downstream face of ogee section, leaves the apron in a thin sheet at high velocity. At a point below the dam the water rises turbulently, forming a so-called "standing wave," hydraulic jump, or "back roll." The thickness of this sheet and the velocity of the water depend upon the height and shape of the downstream face of the dam, upon the depth of water at the crest of the dam, and upon the quantity of water flowing over the dam. The energy developed in this thin sheet of water has generally been regarded heretofore as solely of a destructive nature, but in the backwater suppressor the energy of the spillway water is so directed as to remove the backwater from over the draft tube orifice, sweeping it down stream, thus freeing the draft tube from this pressure of water over it and maintaining a practically uniform head on the turbine as long as the spillway water is able to sweep the backwater away from the draft-tube orifices. The energy of the spillway water not only removes the height of tail water from the draft-tube orifice, but even lowers the normal tail-water level to a perdetermined depth.

MODELS TESTED.

In order to substantiate the idea and evolve a definite theory on which to base the calculation, a model was constructed on a 1 : 24 scale at East Lake in Birmingham, Ala., where a small flow at 3 ft. head was available. The results obtained were so interesting that, to check the data obtained and to increase the accuracy of measurement, a second and larger model was constructed on a 1 : 10 scale at Jackson Shoals, Ala., where a greater flow and head were available.

The results obtained with the two models, when reduced to the same scale, were in close agreement, and the observed results followed those calculated for similar conditions.

Each consists of a forebay for stilling the water, a spillway having the usual ogee section, a draft tube with its orifice located directly under the spillway, and a tail-water wasteway.

The heights of the water in the forebay, wasteway and draft tube were measured in glass gauges conveniently located on central platforms. By means of these, measurements corresponding to the pond-level head above the river bed, the effective turbine head, the depth of water over the spillway, and the backwater head could be conveniently determined.

Weirs were used in admitting water to the draft tube so that the amount could be accurately measured. This amount was ordinarily maintained to correspond to a normal turbine discharge. Bear-trap stop logs were provided at the end of the wasteway by which the height of the water in the wasteway could be varied to simulate backwater.

(To be continued.)

There is quite a good deal of opposition to hell these days, but what everybody knows who has lived long enough, is that if there isn't any hell, there ought to be.

Benjamin again!
The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of
CORRECT ARTIFICIAL LIGHTING
Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N. 17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription : 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

The Future of the Electric Tramway.

I have so often commented on the obsolescence of the electric tramway for modern city transport that it is only fair to give equal publicity to the views of those who have the interests of this form of locomotion at heart and are doing their best to prolong its existence. Thus a writer in the *Model Engineer and Electrician* predicts that in many towns the present tramway track when worn out will not be relaid. What will happen is that the trackless bus will continue to make use of the overhead trolley wires, and work without the trouble and expense of relaying the track. In the larger towns, however, it is probable that recent developments in the way of rather lighter and larger cars, due to the use of high-class alloys and special metals, will permit the tramway to reduce its running expenses; whilst the ability to take advantage of the higher speeds available will be secured by running the tramway on a special track of its own outside the immediate thronged city area.

According to the above authority this idea is mooted in several influential quarters; its object is to allow the tram to pick up, as at present, along the purely urban portion of the district, and then to serve the outer suburbs with a fast and greatly accelerated servise of cars running at twenty miles an hour or more on their own tracks at the side of the modern well laid out wide roads which are now under construction. This would permit the tramway to serve a much wider area, to carry a given population with fewer cars and to do so at a very cheap rate. Returns from reliable sources taken over the whole country show the electric tram to be still the cheapest means of transport per seat per mile (this may be due in some cities to the fact that one seat is made to serve for quite a number of passengers), and developments, as sketched out above, would bring these costs still further down.

The two principal advantages which the tramcar possesses over the petrol 'bus are the very large seating capacity of the electric tram in all weathers, and its ability to draw 100 per cent. more energy from the line than is normally used, whenever gradients or heavy loads call for it. It also has the advantage that the direct-current series motor will stand temporary overloading of this type without distress. These two assets, high power at instant demand and large seating capacity with safety and comfort, it is claimed, compensate for the serious drawbacks of inflexibility and high initial cost. Apropos the foregoing defence of the electric tramway it is significant that the Highways Committee of the L.C.C. have recently held an inquiry into the relative efficiency of the two means of transport and also of trackless trams.

The following conclusions, which may be relied upon as thoroughly trustworthy, have been arrived at, viz. : That trams seat 50 per cent. more; in wet weather their advantage over the other two systems is 200 per cent. Trams are under better control, they do not skid and they travel faster. Trams cost least per mile per seat. They do not damage the roads so much as the omnibuses or trolley cars. They continue running in fog or snow long after the omnibuses have stopped. Omnibuses have more flexibility, but this quality is not available in really congested streets. It should be remembered, adds the Committee, that tramcars are excluded from the profitable Central London area of many short journeys.

In this last rider lies the crux of the whole question. Is it possible to imagine the streets of Central London permeated with tramway tracks and ponderous tramcars? The idea is wholly impracticable, and is rapidly becoming so in other of our large provincial cities, which, in the course of a few more years, will be unable to accommodate tramway cars in their central thoroughfares now so terribly congested with more flexible and independent vehicles. Moreover, the L.C.C. tramways admittedly do not pay; they show a financial loss on each year's working, and the country cannot afford to support non-paying services indefinitely. No, the future of the tramway lies in serving urban areas outside busy city districts along the lines indicated in my earlier paragraphs, running at high speeds on specially reserved tracks where the cars do not constitute a nuisance to every other user of the road, and where their tracks can be laid and maintained far more cheaply than is possible with a permanent way subject to abnormal wear and tear in the centre of a busy thoroughfare.

As regards City passenger transport services of the future, I incline to the opinion that development will be in the direction of the distributed load rather than any elaboration of the greater passenger capacity per unit as indicated above. The escalator principle, as developed on the tube railways and the moving platform principle exemplified in the "Never-Stop" railway at Wembley, are the ultimate solutions of the traffic congestion problem. Keep the populace moving continuously in the direction in which they desire to travel by means of moving sections of the roadway or sidewalks, and you have practically solved the problem which is at present so troublesome to the police and traffic authorities of London and other big cities. The time lost and congestion caused at rush hours by the necessity for stopping to pick up and set down passengers is a very considerable contributory cause to the traffic congestion of to-day which the continuously travelling platform principle would eventually banish. It may not come in our time, but undoubtedly it will prevail in course of years, and some of the younger generation may yet live to see it in practical operation.

Illuminated Fountains.

There are fewer more beautiful and effective sights than artistically illuminated fountains and moving water effects produced by the projection of variously coloured lights on to cascades or fountains. The older generation of my readers will remember the very beautiful illuminated fountains and cascades which were a feature of the old Earl's Court Exhibitions, and which have no parallel at Wembley. Illuminated fountains are widely employed in the States to add to the attraction of public parks and recreation grounds. Our contemporary, *Municipal Engineering*, gives the following interesting details of an actual installation. The battery is composed of thirty vari-coloured flood lights, consisting of five groups of six each, each group having the colours red, white, blue, green, and amber, with purple or vermilion supplying the sixth colour as desired.

A 500-watt lamp is used in all except the blue and green units, in which a 1,000-watt lamp is employed. A 1,000-watt lamp is used also in each unit in the centre of each group. The average load while the fountain is in operation is 10 kw., which indicates the low cost of the illumination. Through a window in the control house, a short dstance from the fountain, the operator can observe the results of the combinations of colours and water. Each light is operated by a snap switch, with the colour it controls indicated, and a great variety of combinations may be had by a proper manipulation of the switches. The water is controlled by quick-acting valves on the wall of the control house. One man, seated, is able to run the complete display with ease. Each flood light is of a certain colour, the colour being obtained by means of a coloured door glass, the different colours being blown in the heat-resisting glass so as to be permanent. A floodlight is placed under the centre of each ring, and five others are installed as close to the centre one as possible, spaced equally around the ring. Silvered reflectors are used with the units in the centre of the ring, and with the blue and green units, thirteen in all. Aluminium reflectors are used with the others, a total of seventeen. Some such installation would prove an added attraction to the existing delights of the British Empire Exhibition, and there is plenty of time to instal such a display in the neighbourhood of the central lake before the darker evenings are upon us to give maximum effect to the display.

A Too-Efficient Electric Heater.

A few days ago I was examining a specially designed electric "tank" (as it is called), which was constructed for the testing of thermometers and thermo-couple sets up to about 700 deg. F., which is the limit of temperature indicators used in the actual steam side of generating plant. This tank is electrically operated upon the transformer principle. A primary winding, insulated for the current and for heat, surrounds the metallic container, which holds a solution; the heavy currents set up in the container (which acts as the transformer secondary) give rise to the heat which is communicated to the solution, the standard and other thermometers being inserted in the latter.

Well, I was looking again at the tank and noting the ravages of time and use. The wooden cheek of the primary winding appeared to have long since vanished. I idly glanced through the log book, and upon one of the pages I came across the following dramatic announcement (which incidentally explained the mystery of the wooden cheek):—

> Tank gone west. Wooden top plate on fire. This was allowed to burn *as the fire brigade is on its annual day's excursion to Whitley-on-Sea.*

This reminds me of an incident during my experience in the Army. A house had been burnt down not far away from the camp, the Army not being called in until too late. We heard that the house would have been saved were it not that the tractive power for the local fire-engine was missing—the horse was working in a field several miles away!

Fire!

To return to our own technical field. I remember an occasion when a small potential transformer designed for 40 volts, was, during a test, left on a higher frequency than the rated value, and, whilst we were absent, became abnormally hot. When we returned the transformer was missing. A young fellow was standing by with an air of interest. Did he know anything about it? Oh, yes, he did! He explained that he had seen the transformer steaming and, with tremendous presence of mind, had switched it off, disconnected it, taken it into the yard, and there thrown a bucket of water upon it. He recounted all this in tones of great animation and satisfaction, and was, I fear me, sadly taken aback by our cold reception. The only cheering fact in the situation was that the energetic young fellow had not flung the bucket of water upon the transformer (and the rest of the apparatus) before removing it! And I remember, not without a smile, an occasion when I was using a very special standard meter, which was placed beside a regulating rheostat. The latter was somewhat damp and overloaded, and murky fumes began to rise. My chief was some distance away. Suddenly I heard an exclamation of alarm, and he came dashing up in a state of great perturbation. From where he had been standing it appeared as though the fumes were rising from the very special standard meter! Hence the excitement!

ELEKTRON.

LONDON AND HOME COUNTIES ELECTRICITY DISTRICT.

The Electricity Commissioners have made an Order under Section 7 of the Electricity (Supply) Act, 1919, giving effect to the scheme approved by them, and the Order has been submitted by them to the Minister of Transport for confirmation in accordance with the provisions of Sections 7 of the Act of 1919. Copies may be obtained from the Secretary at Gwydyr House, Whitehall, S.W.1.

THE WRITTEN APPLICATION—AND ITS CHANCES OF SUCCESS.

By Another Manager.

The man who essays the task of answering an advertisement appearing under the heading of "Situations Vacant" has many difficulties to contend with, and particularly if (as is nearly always the case) the firm advertising modestly veils its identity under a box number. It is not always the applicant's fault that his letter fails in its object, for, setting aside the obvious fact that only one of the many applicants can secure the appointment, it is not always the case that the best letter (even when judged by the specific circumstances) succeeds.

As one who has written more than one hundred applications for employment, and who, by a turn of fortune's wheel, has had to engage labour of various grades, the writer claims to have some knowledge of the subject, and he was particularly interested in the article by "A Manager" which appeared recently in the columns of Electricity. With many of the conclusions reached the present writer is in complete agreement, but there are others to which he takes exception, as well as to the general tone of the article, which seems to imply that the writer of the application is to blame for his non-success.

There are several factors that contribute to the rejection of an application, and of these but two or three are controlled by the applicant. Putting the latter first, the most important is the obviously unsuitable application, penned by the man who is determined to have a shot at everything on the chance that he may strike lucky. Most people contend that this man would do better to confine his efforts to those advertisements within the scope of his capabilities, but many would be surprised to know that these "long shots" frequently come off, particularly if salary is the all-important question. Assuming that the salary asked by the qualified applicants is more than the advertiser is prepared to give, it can be taken for granted that he will look through the letters for a "promising applicant" who is asking a modest salary, and it is in this way that the "long shot" scores.

But the obviously unsuitable application need not necessarily be penned by the man who is merely "taking a chance," for it is often sent by people who have been misled by the ambiguous or flamboyant wording of the advertisement. In this connection the real fault lies with the advertiser, and so far from the latter having a grievance against the writer of an "obviously unsuitable," the reverse is the case. As a matter of fact, comparatively few firms know how to word an advertisement in such a way as to render it perfectly intelligible, and apart from this there is considerable diversity in trade terms which is very confusing.

Again, the size of the concern advertising has an important influence, and this is where the "hidden identity" is at fault. The man, seeing an advertisement for a storekeeper, does not know whether the post is with a firm employing 100 hands, or with one employing 2,000. He may be quite competent for the post with a small firm, but as the advertisement is at the instance of a large concern, his application is dubbed "obviously unsuitable." Conversely, the man whose salary expectations are, say, £350 a year is induced to apply for a post carrying a salary of £3 a week. This latter has been the writer's own experience.

The next factor of importance is that often the applicant does not know how to put a letter together—he is rambling, or much too brief. It has to be remembered, however, that comparatively few people are good letter writers, whilst many of those who are good writers are very indifferent workers. The present writer is not in agreement with the suggestion that applicants should obtain expert help for writing their letters, for apart from the fact that such letters would convey a wrong impression, the average applicant has no money to risk on "expert's" fees, the return for which is in "the lap of the gods."

In the writer's opinion, too much importance is placed upon the letter, and the manager receiving written applications would do well to cultivate the art of reading between the lines. If he has had experience in writing applications as well as reading them this should not be difficult of accomplishment, and he will not have to waste much time in coming to a decision.

Now, a word or two about the factors over which the applicant has no control:—(1) An advertisement is inserted in a London daily paper, and appears on Monday, Tuesday and Wednesday. He does not see the paper on Monday, but he does on the following day, and forthwith sends in his application, which is not even glanced at, because the selection was made from the letters received in reply to Monday's announcement; (2) the advertisement is sent to a daily paper, and also to a weekly trade journal. The applicant sees the announcement in the trade paper, but is too late in sending in his application because the matter is settled before the replies are received in response to the announcement appearing in the weekly journal; (3) the advertisement is sent to two weekly trade journals, but whereas one will publish the announcement at the end of the week in which it is sent, the other does not publish it until a week later. What chances have the readers of the latter journal?

The number of replies received is another "uncontrolled" factor from the applicant's standpoint. One manager confessed to the writer that in response to one advertisement so many replies were received that the whole were burned unopened, and a selection made from those who applied personally.

The success or otherwise of the written application nowadays is largely a matter of chance and will continue to be so until trade improves and there is little surplus labour. Again, there is the mentality of the manager to contend with. One will be favourably impressed by the letter that no one else will give a second thought to. The manager who wrote the article in a recent number favours the typewritten letter, but this will not commend itself to many managers who are receiving written applications. His comments in regard to the £10,000 a year man and "the investor" coincide with the views of the present writer, and need not be enlarged upon, except that, in regard to "the investor," such advertisements, especially in view of the slogan "Truth in Advertising," should be excluded from the Press.

B.I. Fair, 1924.—A limited number of copies of the catalogue of the British Industries Fair, 1924, are still available and may be obtained, price one shilling each post free, on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. In view of the detailed nature of the information contained in this catalogue, it is thought that the work should prove of use as a book of reference to firms who were unable to attend the Fair, but who require information as to where to place orders or make inquiries regarding any special class of goods.

THE MARRYAT AND SCOTT LIFT AT WEMBLEY.

Messrs. Marryat and Scott, Ltd., are exhibiting a full-sized electric passenger lift in complete working order at their stand No. 35, Bay 5, Avenue 7, in the Palace of Engineering. The machine, which is in every respect a standard model, is so arranged that any individual part can be opened up for full inspection by those interested, and is at the disposal of any consulting engineer or architect for the purpose of conducting any tests or trials that they may be interested in. The makers venture to think that this will be advantageous to many, as electric lifts, when completed, are very rarely able to be used for this purpose.

Special attention is drawn to the finish, both from the point of view of component parts and the general appearance. This clearly illustrates their endeavours to produce a machine which, whilst being absolutely sound electrically and mechanically, can be relied upon to harmonise with the interior design of any building.

Those interested are cordially invited to visit the stand, where they will find a staff of keen engineers who will be pleased to give any information that may be asked for. The makers report that business at the exhibition is extremely brisk, and that a large number of inquiries have been received for lift equipment required in this country and abroad, and further, that many orders have already been booked.

Early History.—It is known to few that the late Mr. Robert Applegarth was the first man to give a public exhibition of the electric light in London—it was at the West India Docks, and the date was June 15, 1877. Later he was instrumental in getting up an Electrical Exhibition at the Crystal Palace, and he had the honour of conducting Mr. Gladstone to see this new marvel in the art of illumination.

THE AUSTRALIAN ELECTRICAL WIRING RULES.

His Majesty's Trade Commissioner at Sydney has forwarded to the Department of Overseas Trade, copies of the recently revised Electrical Wiring Rules of the Institution of Engineers, Australia. These rules are applicable to all States of the Commonwealth, with the exception of Victoria, where the rules of the State Electricity Commission have statutory powers. The differences between the two sets of rules are not, however, of very great moment. The above rules may be consulted by interested United Kingdom firms on application to the Department of Overseas Trade (Room 52), 35, Old Queen Street, London, S.W.1. (Reference No. B.X.1118.)

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 186.

When viewing a cinematograph picture, the wheels of a carriage appeared to be turning backwards. Can any reader explain this to me?—"INQUISITIVE."

QUESTION NO. 187.

I wish to use a 100 volt., 3 amp. D.C. motor on 210 volts. Can any reader tell me how to construct a resistance to enable this to be done, since I am told that this is the most economical way of doing it?—"H. W. MAY."

(*Replies to Questions Nos.* 186 *and* 187 *must be received not later than August* 30, 1924.)

A Conference on Illuminating Engineering.—We understand that a Conference on Illuminating Engineering has been arranged to take place at the British Empire Exhibition on the afternoon of Tuesday, August 12. Amongst other items a report on the proceedings at the First International Conference on Industrial Hygiene and the meeting of the International Illumination Commission held in Geneva will be presented, and special attention will be devoted to progress in the lighting of schools and factories. It is also anticipated that the subject of Exhibition Lighting will be discussed, and Mr. Haydn T. Harrison has consented to give an address on this subject. We note that, in connection with public lighting, a paper entitled "The Illumination of Highways from the Motorist's Point of View" is to be presented by Mr. Edward Fryer, head of the Road Department, Automobile Association. Further particulars and tickets for the conference, which will be open to all interested in the subject of illumination, are obtainable from the Hon. Secretary of the Illuminating Engineering Society (Mr. L. Gaster, 32, Victoria Street, London, S.W.1).

Reviews of Books, &c.

[Books noticed in this column will be sent from ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

B.E.S.A. PUBLICATION NO. 204-1924: BRITISH STANDARD LIST OF TERMS AND DEFINITIONS USED IN CONNECTION WITH TELEGRAPHS AND TELEPHONES. (1s. 2d. post free.)—This list forms one of the eleven sections of the British Standard Glossary of Terms used in Electrical Engineering which is now nearing completion and will be issued shortly by the B.E.S.A. The definitions in this section have been drawn up in co-operation with the Am. Inst. E.E. and the Am. Eng. Standards C'tees., thus ensuring uniformity in nomenclature as far as possible among telegraph and telephone engineers in this country and in America. The list includes a revision and extension of B.E.S.A. Publication No. 136-1920: Terms and Definitions for use in Connection with Automatic Telephone Systems, this latter publication being now replaced, therefore, by the new list. It contains definitions of about 230 terms, grouped into eight sub-sections to facilitate easy reference. An alphabetical index is also included, giving full cross references.

The arrangement of the list is similar to that adopted in B.E.S.A. Publication No. 166-1923: Terms and Definitions used in Radio Communication, this being the only other section of the Glossary already published. Where a given definition applies to more than one term, the term recommended for general use is printed in bold type, the other terms being given in lighter type as synonyms of the preferred term.

No. 5027-1924: B.S. DIMENSIONS FOR MAGNETOS FOR INTERNAL COMBUSTION ENGINES. (1s. 2d. post free.)—This specification (which supersedes No. 80-1917) covers four types of magnetos used for internal combustion engines (excluding those for aircraft purposes). The dimensions standardised are those which affect the interchangeability of magnetos as a whole. Recommendations are also made in regard to the width of the engine coupling, flange mounting, and the sparking position in relation to the keyway in the tapered end of the armature spindle. Full particulars are given for the plug and ring gauges for checking the taper in the magneto coupling and on the armature spindle.

Holidays.—The works of the Automatic and Electric Furnaces, Ltd., at 173-175, Farringdon Road, London, E.C.1, will be closed from August 2 to August 10 inclusive. The demonstration rooms and offices will, however, remain open with the exception of Bank Holiday, Monday, August 4.

Obituary.—We regret to report the death on July 8 of Mr. Benjamin G. Lamme, Chief Engineer of the Westinghouse Electric and Manufacturing Co., and one of the world's leading electrical authorities, after a lingering illness of several months. His most spectacular achievements were the designing of generating equipment for the World's Fair in Chicago in 1892; 5,000-h.p. generators, a world's record at the time, when Niagara Falls was first harnessed for water power; generating and motor equipment for the first big railway electrification, that of the New York, New Haven and Hartford Railroad; the present-day single-phase alternating current, high voltage railway system, which is responsible for most of the railroad electrifications; the design of the most successful synchronous converter ever used; and the single reduction gear street car motor, which, though designed in 1890, is the type still used on street railway systems. He was born near Springfield, Ohio, on January 12, 1864.

THE ELECTRICAL KITCHEN FOR PRIVATE HOUSES.*

BY PROF. H. BOHLE, M.I.E.E.

(*Continued from page* 385.)

4. ELECTRIC OVENS.

Most electric ovens resemble coal ovens or oil stoves. Some are lagged, others are not. Ovens with heavy case iron frames consume a good deal of energy before they are hot, and are wasteful in energy consumption. The food has to be watched, as is the case with coal ovens. With the servant question becoming more and more difficult, even in this country, the cooking must be made automatic. Once food has been inserted it should be possible to leave the oven to itself. This may be achieved by supplying the oven with either a time switch or, better still, with a heat-controlling switch. It must also be possible to insert dishes with foods requiring various amounts of energy for complete cooking, which means that the temperatures in different parts of the oven must differ. It takes longer to cook with this oven than would be the case on an open fire, but as the oven need not be watched this does not matter. If lunch is required at 1 o'clock, the food must be inserted at 9 a.m., so that all the heat stored in the oven during the switching-in period can be utilised for completing the cooking. The switch can also be set so that very tough materials get a little more energy than fresh articles. The food which requires most energy is placed directly on the hot plate, the goods wanting least at the top, covered with a lid. One pot seals up the one beneath it. The number of pots is usually limited to three. All vessels must consist of aluminium, which transmits the heat from a lower pot to an upper one to a large extent by direct conduction.

AUTOMATIC OVEN.

I have tried two automatic switches, both of which work satisfactorily. The thermostat in the one case consists of a strip of bi-metal, the two parts of which possess different expansion coefficients. The curling up of the strip is communicated to a system of levers for tripping a switch. In the case of a baking oven with a heating element at the top as well as at the bottom, it was not necessary to place the bi-metal directly in the oven.

In the other thermostat the expansion of a liquid, for instance oil, is made use of. As the tube is sealed up there is no danger of sludging of the oil. This thermostat has now been in use in my house for nearly a year, and has worked very satisfactorily. The oven may be set for plate warming, baking and boiling, the temperatures being about 80, 100 and 130 degrees C. An indicator shows the position of the thermostat, so that its working can easily be controlled.

I have no hesitation in stating that the circular oven with a suitable lagging is the most efficient oven on the market, as radiation losses are very small and the heat is fully utilised. Yet some people prefer to be able to look at the goods during the process of cooking, and especially baking, and as it is always advisable to give people what they want, I constructed an automatic baking oven with a door and a window. I used for the purpose an old frame of an oven of a well-known make, replaced the inner iron vessel by aluminium, the open wire elements by a sealed-up type, and placed an automatic switch at the top of the oven. To get the necessary heating surface for the element I employed a corrugated aluminium frame. The oven worked very satisfactorily. The loaves and cakes were inserted after the oven had been heated to the top heat and then entirely left to themselves. There was no need for turning the goods or moving some from the bottom to the top. The distribution of heat was very uniform, and hence the bread and cakes were uniformly brown. The time taken is, however, a little longer than when baking with an open type of element. The heaters, though sealed up, can easily be repaired by removing a single nut.

---

* Abstract of paper read before the S.A. Inst. of Electrical Engineers.

These two ovens suffice for the ordinary household. Both may be used for boiling and baking, which is not the case with an oven which has an iron lining and possesses open wire elements. If such ovens are used for boiling they will be destroyed by rust in a very short time. The old frame used for the baking oven was such an iron-lined structure, completely rusted through. The circular oven also had an iron inner vessel, painted with aluminium paint. This lining lasted nine months. Another oven, made of aluminium, which has been in use for nearly two years, looks as well as it did on the first day. Moreover, the rust tarnishes the aluminium pots within the oven.

(To be continued.)

THE INSTITUTE OF COSTS AND WORKS ACCOUNTANTS.

The members of this Institute represent a very important body of men who have much to do with the success or failure of any commercial undertaking, and due praise was awarded to them on the occasion of the fifth annual dinner, which was held at the Connaught Rooms on the 17th inst., when the President, Viscount Leverhulme, was in the chair. He was supported by various eminent men, including Sir George Paish, Sir Ernest Benn, Mr. and Mrs. A. Williamson, Sir Edgar Sanders, Mr. W. Howard Hazell, Mr. R. A. Austen Leigh, Lieut.-Colonel Sir John Keane, Mr. R. H. Wilson, Sir William Mills, Sir William Berry, and Colonel O. C. Armstrong.

The toast of "The Institute and its branches" was ably proposed by Sir George Paish, who referred to the great difficulties which business firms had been, and were now, facing, and the way in which members of the Institute were helping them to keep out of the Bankruptcy Court. He spoke optimistically of the trade outlook in the near future, and went on to state that in his opinion the world could not recover a full measure of prosperity until Russia recovered. In his reply as President Viscount Leverhulme gave a most interesting speech, in which he touched on the social degradation of Russia, and then went on to complain of the lack of enterprise shown by British Governments in the past in not fostering industries which were really due to British inventive ability. Other toasts included "Kindred Institutes," proposed by Mr. W. Howard Hazell, J.P., in a very humorous vein, and responded to in a similar manner by Sir Ernest Benn, C.B.E.; "The Press," proposed by Sir John Keane and replied to by Sir William Berry, and "The Visitors," by Mr. Wilson, replied to by Mr. Austen Leigh. An excellent programme of instrumental music was provided during the dinner, and the speeches were interspersed with songs by Miss Doris Smerdon and Mr. Charles True, and flute solos by Miss Edith Penville. Altogether, Mr. Nicholls, the secretary of the Institute, is to be congratulated on his organisation of a very successful evening.

Various Items.

Tenders Accepted.—The Aberdeen Line have accepted the tender of the Siemens and English Electric Lamp Co., Ltd., for the supply of gasfilled, helical marine traction and carbon filament lamps.

Finance.—The directors of the Rushden and District E.S. Co., Ltd., have declared an interim dividend of 3½ per cent. per annum, and the directors of the Northampton E.L. and P. Co., Ltd., an interim dividend of 4 per cent. per annum on the ordinary "B" shares. Both payable on August 20.

Personal.—The Siemens and English Electric Lamp Co., Ltd., inform us that they have appointed Mr. R. D. Page (late of their Southampton branch) as branch manager at Newcastle-on-Tyne. Mr. Page's connection with Messrs. Siemens extends back some sixteen years, and he has a very wide electrical experience, which should be of great value in his new sphere of operations.

Certificates.—Sir Charles L. Morgan, C.B.E., president. Inst.C.E., distributed the certificates to the successful students of the Crystal Palace School of Engineering on Tuesday. The occasion was one of unique interest, as it signalised the retirement of the principal, Mr. J. W. Wilson, after 25 years. His brother, Mr. Maurice Wilson, is the new principal. Mr. F. Bailey took the certificate of honour, and Mr. S. C. Soper the medal of the school. Sir Charles urged the importance of students in all parts of the world belonging to the Old Students' Society.

I.E.E. Wiring Rules.—It will interest a very large number of the readers of this paper to hear that the new (8th) edition of the I.E.E. Wiring Rules is now ready, and may be obtained from the office of this paper, price 1s. 2d. net, post free. It can also be obtained bound in cloth for 1s. 8d. net, post free, but this latter edition will not be ready for another few days. We can recommend the new edition to our readers as the very last word in connection with wiring regulations, and are sure that a large number of them will require to purchase copies. They should be ordered promptly.

Colour at the Kensington Palace Hotel.—The intelligent use of colour is undoubtedly one of the best ways by which the up-to-date hotel proprietor caters for the moods of his patrons, and of this an excellent example is afforded in the Empress Rooms of the Kensington Palace Hotel, where three artistic crystal chandeliers have been fitted with Osram colour-sprayed lamps, which produce a warm amber illumination suggestive of brightness and sunshine. The result is a unit which has the beauty of the old times chandelier, with the added qualities of being light-giving and glareless. The even illumination is remarkable, and shadows are entirely absent.

Electrical Mah Jong.—We have to thank the publicity manager of the Western Electric Co., Ltd., for an interesting souvenir of the British Empire Exhibition in the form of a set of electrical mah jong neatly enclosed in case, together with an illustrated booklet of rules and complete instructions. It is a handsome advert. novelty which should prove a great attraction to all who are fortunate enough to receive a set. It can be purchased from the company in the ordinary way at the price of 7s. net, and any *bona-fide* dealer who is interested therein can obtain a set on application to the company's stand in the Palace of Engineering, Avenues 9-10, Bays 18-20. The tiles are neatly elaborated cards representing the various types of telephones manufactured by the company, and the set should prove quite a useful acquisition in any household.

ARMATURE REPAIRS
MARRYAT & PLACE,
28, HATTON GARDEN,
LONDON, E.C. 1.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
A PRACTICAL TRADE JOURNAL

AUGUST 8, 1924

CONTENTS.

	PAGE
Some Considerations Regarding Lifting Magnets	407
Electricity in Agriculture	408
Hydro-Electric Power Plant Design	409
Telegraphy	410
Current Topics	413
The Electrical Kitchen for Private Houses	414
Questions and Answers by Practical Men	416
Reviews of Books	417
Various Items	417
Trade Notes	418

SOME CONSIDERATIONS REGARDING LIFTING MAGNETS.

Lifting magnets are now playing a large part in the moving of iron plates and bars, and moreover, the ease and quickness with which magnets can be operated make them labour- and time-savers, as by merely switching on the magnetising current, the materials may be lifted and then moved about by the crane.

The adhesive force or "traction" of a magnet depends on a variety of factors. When good contact obtains, traction is high; when there is bad contact, as in a rough or uneven surface, traction is low. If the pull is exerted through a distance, the air-gap increases the reluctance and so reduces the current—thus lessening the lifting power.

Formula for tractive force.—Maxwell has given the following expression for the lifting power, in terms of absolute units, viz.:—

$$P = \frac{B^2A}{8\pi}$$

where P = pull in dynes
B = flux (lines per sq. centimetre)
A = contact area, in sq. inches
π = 3.1416

and in engineering units, the formula reduces to

$$P = \frac{B^2A}{7.2134 \times 10^6}$$

P being in pounds, B flux in lines per square inch, and A the area in square inches. Both of these show that the pull varies as the square of the flux and as the contact area, but it is well to remember that magnetic leakage may occur and that the flux is not distributed uniformly. Further, when the expressions are examined closely, if the flux is constant and A is increased, then B will be diminished, as in this case the same number of lines would be spread over a larger area, and so traction would be lessened. Again, by decreasing A, traction will be greater, and though this may seem paradoxical, it is quite true, because the pull varying only as A, and as the square of B, clearly therefore by making A less, B and therefore its square is increased, the net result being that P has a higher value.

In designing lifting magnets, the points to be borne in mind are:—

(a) The length of the magnetic circuit should be as small as possible and the cross-section as large as possible, so as to keep down the reluctance.

(b) Iron of high permeability should be employed for core and yoke.

(c) The flux density should not be too high, an outside limit of 100,000 lines per square inch being the greatest allowable at the poles, otherwise the weight of the copper to provide the ampere-turns becomes a matter of importance.

The following values connecting flux density B and pull p. show that p varies as B^2, and this is identical with the formula already given, A becoming unity:—

FLUX DENSITY (B) LINES PER SQ. INCH.	PULL (p) POUNDS PER SQ. INCH.
10,000	1.39
20,000	5.55
40,000	22.20
60,000	49.90
80,000	88.72
100,000	138.63

The cores and yoke in the usual form of lifting magnet are of mild steel, mostly rectangular in section; the coil for excitation is protected, and well insulated before being put on. The magnet is in one casting, and weighs about half a ton. It is so constructed that with a power expenditure of 3,250 watts or 4.34 h.p., a weight of 12 tons may be lifted.

Calculation of ampere-turns.—Trials are made with varying lengths and thicknesses of core, and distance between core centres, so as to give a definite B value. Suppose the cross-section is $4\frac{3}{4}$ in. by $3\frac{1}{4}$ in. and the total flux 1,000,000 lines, then B is equal to $\frac{1{,}000{,}000}{4\frac{3}{4} \times 3\frac{1}{4}}$ or nearly 65,000 lines per square inch in the yoke.

For the magnet cores, the ampere-turns per inch length is about 80 for cast steel with a flux density of 92,000 lines. If the path in each is, say, 7 inches, then the ampere-turns required will be $2 \times 7 \times 80 = 1{,}120$.

For the yoke, the ampere-turns per inch length for a B value of 65,000 is, say, 20, and taking the length of the path as 8.75 inches, and the armature path and B value the same as the yoke, this gives $2 \times 8.75 \times 20 = 350$ ampere-turns.

The air-gap is that part of the circuit requiring the largest number of ampere-turns. If $\frac{1}{16}$ inch be allowed, then for the two gaps we have $\frac{1}{8}$ in., and on the assumption that the density at the poles is 100,000 lines, then the ampere-turns required will be .313 (a constant in inch units) $\times \frac{1}{8} \times 100{,}000 = 3{,}900$.

This would give a total of $1{,}130 + 350 + 3{,}900 = 5{,}380$ for core, yoke, armature and air-gap.

Generation of heat in the coils.—This will be a measure of the lost watts, the product of the current (C) and the voltage across the coil terminals (E), or as C^2R watts, where R is the resistance offered by the coil. Assuming that this heat is dissipated as quickly as it is produced, there will be no temperature rise, but if the latter is quicker than the former there will be a rise, and in practice it is usual to arrange for the coil dimensions to be such that this rise shall not exceed 55° to 70° F. Under cool conditions, 2.5 square inches per watt, and in a hot room 4.5 square inches per watt, may be allowed. Where the magnet cools down by not being in use a much less area per watt is required for radiation.

Area of wire required at a given voltage. This is given by the expression

$$A = \frac{9{\cdot}47 \times CT \times l}{E \times 10^6} \quad \text{where A = area in sq. inches.}$$

CT = ampere-turns
l = length per turn in feet.
E = line e.m.f.

the area so found corresponding to a given number in the S.W.G. list.

Copper loss (C^2R) ***in the coils.***—An example may serve to show how this may be calculated. Suppose, as above, that 5,380 ampere-turns are required, that 2 square inches of surface per watt are sufficient for radiation and that the voltage is 220. If the effective radiating surface of both coils is 200 square inches, then the power lost will be 100 watts, and the current will be $\frac{EC}{E} = \frac{100}{220} = {\cdot}45$ ampere. Knowing that the ampere-turns are 5,380 and one of the factors C equals ·45 ampere, then the number of turns will be $\frac{5{,}380}{{\cdot}45}$, that is, nearly 12,000, or 6,000 turns on each.

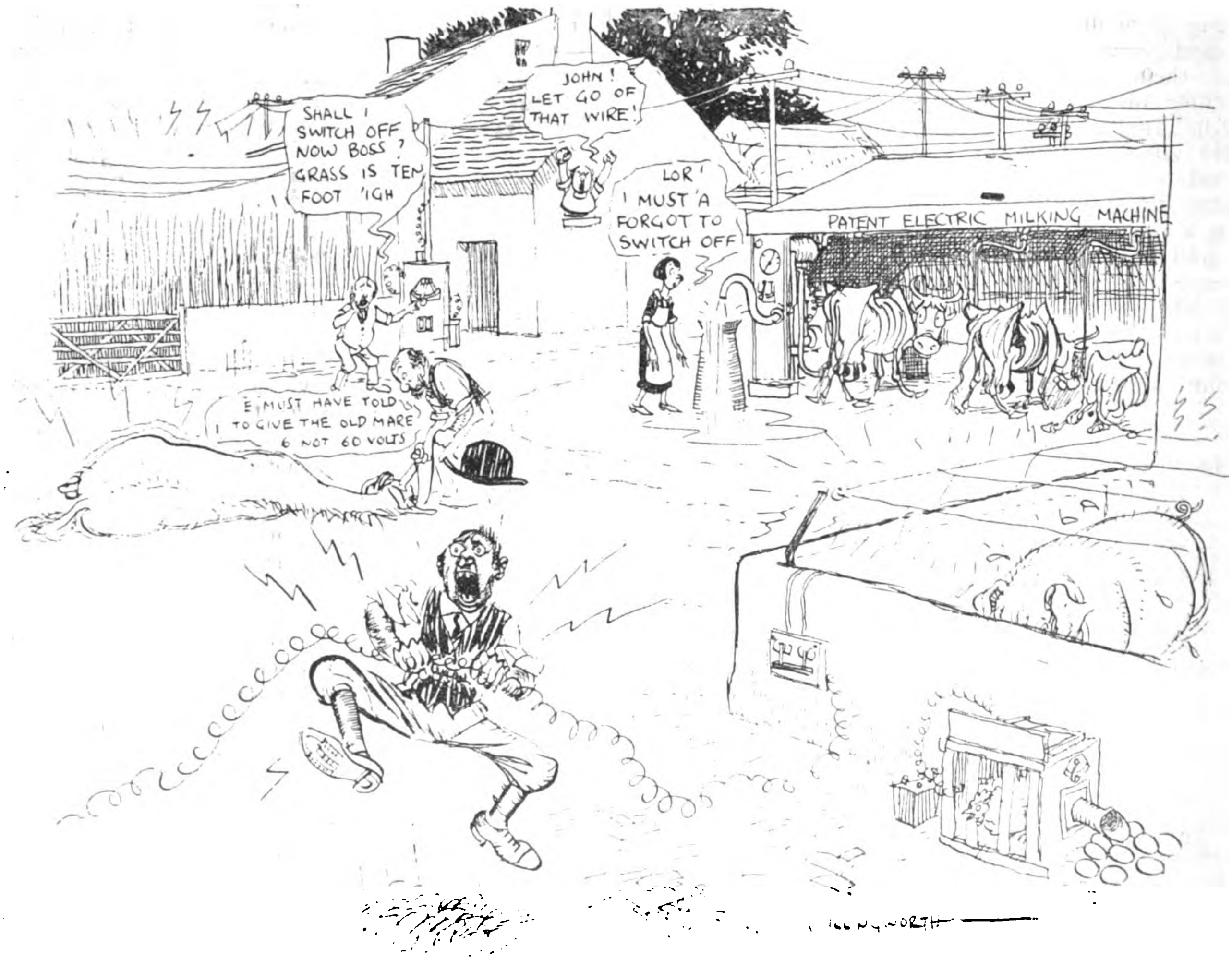
ELECTRICITY IN AGRICULTURE.

The annexed humorous sketch is from our contemporary, the *Western Mail*, of Cardiff, for Friday, July 25, and is accompanied by the following footnote:—

Farming a la Mond.

(Sir Alfred Mond is advocating electrical farming in Carmarthen. We venture to suggest that, perhaps, it would not be as effective as he imagines.)

Evidently the teachings of Mr. Borlase Mathews are bearing fruit in various directions, and we may look forward to a steady flow of visitors from South Wales to the electric farm exhibit at Wembley. They might then look more hopefully on Sir Alfred Mond's suggestion.


SHALL I SWITCH OFF NOW BOSS? GRASS IS TEN FOOT 'IGH
JOHN! LET GO OF THAT WIRE!
LOR' I MUST 'A FORGOT TO SWITCH OFF
PATENT ELECTRIC MILKING MACHINE
E MUST HAVE TOLD I TO GIVE THE OLD MARE 6 NOT 60 VOLTS
ILLINGWORTH

FARMING A LA MOND.

HYDRO-ELECTRIC POWER-PLANT DESIGN.

(*Concluded from page* 398.)

CALCULATED AND OBSERVED RESULTS.

The height of the standing wave, taking a section of unit width (1 ft.) and neglecting losses due to the friction of the moving water over the spillway, can be approximated by the empirical formula $h=\sqrt{D^{2}/2\,H^{1/2}}$, in which D is depth of water in feet over the spillway and H the head in feet above the spillway apron. This does not take into account the effect of the turbine water. This factor will increase the height of standing wave, so that the actual results will be somewhat better than as shown by the formula.

The figures of Table I were compiled from three separate tests made at different times, and show the performance of the Jackson Shoals model with 18 in. of water over the spillway in suppressing various heads of backwater.

TABLE I.

SUPPRESSING PERFORMANCE OF JACKSON SHOALS MODEL.

Water over river bed in.	Head without suppressor in.	Head with suppressor in.	Water over river bed in.	Head without suppressor in.	Head with suppressor in.
0	96	..	23¾	71¼	88
½	95½	96½	26	70	87
2¾	95¼	95¾	27½	68½	80
19	77	96¾	29	67	73
20¼	75¾	96½	29¼	66¾	74
21½	74½	97	30¼	65¾	73
22	74	96½	34	62	68¼
22¼	73¾	96¾	35¼	60¾	66
22¾	73¼	96¾	40½	55½	66¾
23¾	72¼	96½	46	50	56½
24½	71¾	89½	..	..	..

It should be noted that very small amounts cause a decrease in head because sufficient velocity has not been given to the draft-tube water to cause a thinning of the sheet over the draft-tube orifice, but when the ratio of spillway to draft-tube water increases to about 1 : 1, the curve takes a decided course upward and reaches its peak and starts falling off again, due to a greater quantity of water passing over the orifice with practically no increase in velocity above that of the point of maximum head. This curve does not represent the best performance possible, but it is typical of the ideal theoretical curve which is shown in the same figure.

It will be noticed that the head drops off slightly as the backwater increases, due to a greater quantity of water necessary to hold the standing wave, until a point is reached where the standing wave is 13.26 in. high and the curve turns sharply down. This point represents the critical stage or the maximum height of backwater capable of being suppressed by a given amount of spillway water. This could be increased by having a design of spillway permitting a greater discharge.

Even after this point is reached a substantial increase in head is obtained, and at the last point plotted, with backwater 50 per cent. of the total head, an increase of 5 in. is recorded.

Each unit must be provided with dividing walls to prevent the water from coming in on the sides and to allow any one unit to operate independently.

The correct height and length of these walls is determined by the backwater and discharge curves of the river at the location of the power house. In the installation of four units the three intermediate walls are at an elevation shown by the backwater curve when the required amount of water to operate four turbines and three suppressors is passing that point. When the fourth suppressor is brought into action these walls simply act as a guide to hold better conditions at the point of wave and prevent surging.

The two outer walls are designed for extreme flood conditions, as any water passing over the walls into the suppressor sheet will cause a loss in head on the turbine and in height of standing wave. However, if there should be spillway gates on both sides of the power-house section equal to the width of two units, it need not be at the maximum high-water elevation, but at the stage shown by the combined discharge passing the power house and side spillway. This is due to the fact that although a perfect standing wave is not formed at the toe of the side spillways, a lower elevation is created that will be further down stream when the true backwater elevation is measured.

Encouraged by the splendid results of the model tests and the economic advantages of the undertaking disclosed by careful analysis, the Alabama Power Company decided to apply the backwater suppressor at Mitchell Dam on the Coosa River, in Alabama, which is now under construction. The estimates showed that not only was the cost of the suppressor-type plant not higher than that of a conventional-type plant of equal output, but even lower in cost for the same number of units, and therefore for a given output the suppressor-type plant was considerably less expensive.

The principal and most outstanding feature in this plant is the location of the power units on separate foundations in the river on the upstream side of the dam. Although this was not necessarily the only possible way to build the power house, it was the most economical. The river at this point being comparatively narrow, the entire length of the dam was required for spillway, and since the prime requisite of this type of plant is that the draft-tube discharge directly under the spillway section, the units had to be so located that they would not obstruct any part of the spillway section.

The individual and separate power-house units offer the added advantage that trash racks do not present a solid front, which helps materially in cleaning them and affords an easy and convenient way of diverting the trash past the power house and over the spillway.

The usual power-house building is entirely eliminated. The generator room is covered with a low roof, which is designed in two sections, joined on the transverse line, mounted on rollers, each section moving in opposite direction. In normal operation the generator room is completely protected from the weather, but for handling large parts of the machinery, this roof can be opened and a crane utilised for performing the necessary work.

A single gantry crane with full travel over the entire length of power-house section is so designed that everything, with the exception of spillway gates, can be handled by it. It is equipped with one 125-ton and one 20-ton hook, the former for handling heavy machinery and the latter for raising and lowering penstock gates, handling racks, stop logs and all other lighter parts.

An outdoor transformer and high-voltage switching station is located on the bridge over the spillway. This plant is designed for operation on unit system, i.e., the generator and its bank of step-up transformers are connected as a unit, and all principal switching is to be done with the high-voltage circuit breakers. In stations where units are of large capacity, as in the 20,000 k.v.a. plant under discussion, the unit system is very economical and preferable, as it presents the simplest, yet sufficiently flexible, form of operation.

The entire operating floor is on one floor level. The generators, governors, switchboard, low - tension switches, bus galleries and offices are easily reached without climbing stairs or ladders. This materially adds to the convenience of operators and makes the supervision and inspection of the plant more effective. This feature of providing easy accessibility to all important parts of the station is very frequently lost sight of by power-house designers, and the lack of these conveniences has been the cause of inefficient operation or even of breakdowns, due to the fact that operators have neglected the equipment to a lesser or greater degree.

The generators are so installed that the hot air from the generator is discharged into a separate compartment under the main floor and is expelled into the atmosphere through side openings of that room in summer time, thereby keeping the generator room reasonably cool. In winter, however, when heat in the rooms is desired, the outside openings can be closed, and through registers in the floor the warm air enters the generator room.

The penstock does not represent a true scroll casing, but rather a combination of scroll effect and open flame. The water velocities in the penstock being low, approximately 4 ft. per second, this combination affords a better design.

The location of power-house units on the upstream face of the dam lengthened the discharge tunnel to a distance of about 120 ft. from the centre line of the unit. Although the velocity of the discharge is only 4 ft. per second, the effect of this long column of moving water had to be carefully investigated and studied. This problem was solved satisfactorily by increasing the governor action to $3\frac{1}{2}$ seconds and setting the turbine to the lowest practical level. Turbine settings always should be as low as possible, especially where improved draft tubes are employed. Many of the troubles in existing power plants, such as pitting of runners, excessive vibration, etc., can be directly traced to high wheel settings, particularly with high specific speed runners.

Although little has been said about the electrical equipment, it is one of the most important parts of the installation, and should always receive close study and serious consideration if economical and efficient operation is expected.

TELEGRAPHY.*

Being solutions to the questions set at the Grade I. examination in Telegraphy held by the City and Guilds of London Institute, on April 30, 1924.

(*Continued from page 398.*)

Q.—How would you locate a high-resistance earth fault on a line, another good line being available? Give a diagram of the connections employed in the test.

A.—The distance of the fault may be found by means of a Wheatstone bridge set.

The test is made as follows:—Connect the end of the second wire to terminal *A* of the bridge (Fig. 5), and the end of the faulty wire to terminal *D*, and request the distant station to loop the wires.

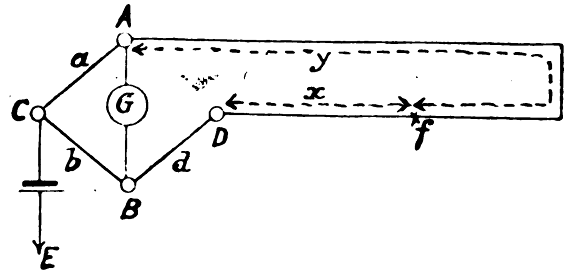


Fig. 5.

By the principle of the bridge we have

$$by = a(d+x) \qquad \ldots\ldots (1)$$

By the total resistance of the loop, $L = x + y$

$$\therefore y = L - x$$

Substituting in (1) above—

$$b(L-x) = a(d+x)$$

whence

$$x = \frac{bL-ad}{a+b} \qquad \ldots\ldots (2)$$

If the ratio arms, *ab*, are made equal, equation (2) above reduces to—

$$x = \frac{L-d}{2}$$

Dividing the resistance of the wire by the number of ohms per mile, the distance in miles of the fault from the testing station is obtained.

(*To be Continued.*)

---

* Books recommended are:—*Questions and Solutions in Telegraphy and Telephony, Grade I.*, by Few (Rentell, 5s. 10d., post free), and *The Telegraphists' Guide*, by Bell and Wilson (Rentell, 3s. 10d., post free).

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of

CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N. 17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

More Hot Air?

Ever since the proposed super-power stations for wholesale generation of electrical energy were mooted just after the war, committees, conferences, Parliamentary bodies, engineering and trade associations, to say nothing of the Electricity Commissioners, have sat and talked—and talked—and made suggestions, some feasible, others obviously impracticable, and still in this year of grace, 1924, electricity is just as dear and unavailable to the great majority of the population as it was when the Armistice was signed. So long as conflicting interests and influential monopolists have any say in the matter, either before or behind the scenes, there will still be plenty more "hot air" and no practical solution of the ever-pressing problem of cheap and universal electrical energy.

The very latest proposal emanates from the Chancellor of the Exchequer, Mr. Phillip Snowden, and forms part of the Government scheme for winter work to relieve unemployment. It embraces a scheme for electrical development, costing ten millions, spread over three years. In the course of his address, Mr. Snowden pointed out that there were 532 generating stations, 42 per cent. of which produced less than a million units of electrical energy per station per annum. Opposition to development came not from the power companies, but from the municipalities, who were too parochially minded and did not want to surrender their generating stations. Greater powers of co-ordination were required, and it was decided that the Electricity Commissioners should be invested with the powers which it was at first proposed to bestow on them in 1919. Legislation for this purpose would be undertaken next session. The numerous electricity works throughout the country were producing electricity of a great variety of frequencies, and before they could be linked up it would be necessary to standardise.

It was not to the financial advantage of the companies to carry through standardisation. It would not be done unless the State undertook it, and the Government had authorised the greatest expert on electricity in the country to enter into negotiations with the companies and the municipalities as to the terms on which the linking-up could be done. Another field of State enterprise was the provision of transmission lines to carry the energy into rural districts. This would not be done unless the State shouldered the greater part of the financial burden. The Electricity Commissioners were to hold a conference with the electricity undertakings with a view to securing the maximum possible development of the main transmission system on certain terms. One effect of this development might be the transfer of industries from large centres of population to the country districts.

One of the reasons why municipalities offer opposition to any such scheme as that above outlined is not far to seek. One has only to note the periodical published statements in the Press of profits earned by the various municipal electricity undertakings and subsequently dissipated in rate relief, to realise that most of these corporations look upon such a suggestion as the slaying of the proverbial goose. It never has occurred, and presumably never will occur, to these parochially-minded municipalities that the subsidising of other municipal ventures at the expense of their electricity undertakings is the reverse of sound finance, and that the persons most justly entitled to benefit by such profits are the local consumers of electrical energy.

In the main these parochially-minded bodies argue that such sums as remain in excess after the payment of all charges are generally insufficient to justify an immediate reduction in the tariff to the consumer. In a general sense they are too short-sighted to realise that reduced charges spell an increased clientèle, and that, pursued to its logical conclusion, successive reductions of the local charge per unit consumed would result in an even larger turnover and a more financially stable undertaking. The calculations are almost invariably based on the resultant smaller revenue accruing from *the same* number of consumers, and this policy, coupled with a lamentable display of apathy towards mains extensions and the canvassing of new and incompletely-served districts, has resulted in the present deplorably backward state of our electricity supply services.

In the circumstances it is refreshing to note a progressive spirit in one or two of the centres of population which have built up unenviable past records for stultification of electricity supply. Thus Liverpool, until quite recently one of the least enterprising of cities in regard to electricity development, has just come forward with an ambitious scheme which, if realised, should go far towards restoring its lost laurels. Mr. Thomas White, chairman of the local Housing Committee, states that he hopes to create an electric city. Of 1,000 new houses and 121 flat residences projected under the housing scheme, it is proposed to electrify them throughout. The Housing Committee's decision in this connection will be largely influenced by the policy pursued by the Tramways and Electric Lighting Committee, who have under consideration a scheme for reducing very considerably the charges for electricity to Liverpool householders. Bravo! Mr. Thomas White; if you succeed you will have done for Liverpool what no other councillor has succeeded in doing for the past twenty-five years.

Straws and the Wind.

Apropos Mr. Snowden's speech on unemployment relief schemes, he asked whether some of our industries had not a larger unmber of people dependent on them than they could bear, and suggested that the policy of the minute sub-division of labour might have to be reviewed. Instead of training a man to do a highly-skilled job, and training him to do nothing but that job, would it not be better to train all-round craftsmen, so that if one particular branch in a trade happened to be depressed men could transfer their efforts to other branches. This significant utterance by a prominent minister in a Labour Government discloses a recognition of the fact that the existing industrial principal of mass production and specialisation in jobs does not make for beer and skittles all the time. I have long held the opinion that one of the primary causes of present-day industrial discontent is the deadly monotony of the average occupation, made still more so by the practice of motion study and the all-round speeding up of human endeavour.

Get back in a measure to the old craftsmanship when each wage earner learnt a trade in the full sense of the term, and was able to carry out all the essential operations individually whenever occasion required, and we shall have solved half our labour problems. But what of the trades unions? At present the man who wields a hammer to drive home a common or garden nail in woodwork must not swop jobs with him who wields the same hammer to knock up a burst water pipe. One is a joiner the other a plumber (save the mark); it is unlikely, having regard to extreme trades union principles, that the representative bodies would agree that the man who pulls a lever to drill a hole in metal on a drill press shall come in the same category as he who presses a pedal to release a power press for punching out some design in sheet metal.

Let the master of the lever transgress over the unwritten law which precludes him from putting a foot to the pedal of the press-minder and the fat is in the fire; probably a national strike within twenty-four hours over alleged blacklegging. No; let us get back, if we can, to the principle of the really skilled craftsman capable of undertaking any task within the purview of the trade he represents, but let us have industrial peace to start with and a proper understanding as between employer and employed, free from all Bolshevik or Communistic influences. Rid the real British workman of his Moscow dictators and bring him to the conference table uninfluenced by the preachings of those who aim at the downfall of all social law and order, and all will be well in the land. I trust the Labour Cabinet will take Mr Snowden's comments to heart and act accordingly.

Elektron.

THE ELECTRICAL KITCHEN FOR PRIVATE HOUSES.*

By Prof. H. Bohle, M.I.E.E.

(*Continued from page* 406.)

The baking oven as made out of the old frame had the disadvantage of too light a lining and too heavy a door. Two windows are unnecessary, and a single narrow one in the middle is sufficient. The door should be as light as possible and should be well lagged. The heaviest lagging should be at the top. With these alterations the oven will be a good proposition. Yet even then the current consumption will exceed that of the circular oven by 50 per cent., as the rectangle offers a larger heating surface and corners radiate more than an even circular surface would. The circular oven is undoubtedly the scientific one.

The cooking in sealed-up pots has the advantage that less water is required than when cooking on an open fire. With many vegetables, such as French beans or cabbages, it is sufficient to limit the water to that which clings to the beans when washing them. This results in considerable saving of energy, as it is the water which has the greatest specific heat. With some cabbages the water should, of course, be thrown away, but with most vegetables this results in throwing away at the same time the nourishing salts, which is avoided with these ovens. The water may with advantage be replaced by some butter or fat.

The shrinkage of meat in a sealed-up pot is almost negligible, because what is withdrawn from the meat is left in the gravy. A piece of sirloin weighing 4 lb. only lost 1¾ ounces, or less than 3 per cent., whereas in an ordinary electric oven the shrinkage amounts to 12 to 18 per cent., and in a coal oven the loss may be as high as 25 to 32 per cent. With such a slow process of roasting, even the toughest meat will become soft if it is left long enough in the oven. But there will be no crust on it, and people who prefer meat with a crust must first put on that crust in an open pot or in the ordinary electric oven, such as the above baking oven minus the pot. White meat done in a sealed-up vessel is always superior to the ordinary roasting, and it is certainly to be recommended for old fowls.

5.—Hot Plates.

Some dishes cannot be made in a closed oven, and hence cooking vessels with heating elements or hot plates suitable for any kind of vessel are necessary. The energy consumption of hot plates differs considerably for various makes. Tests on two hot plates, of which one, plate A, weighed 2¼ lb., while plate B weighed 9¾ lb., both having iron tops, show that for boiling 2,250 grammes of water in a vessel weighing 340 grammes, with the lid, from 17 degrees C., the efficiency of heating with plate B is less than half that of plate A, as most of the energy is used for heating the plate. Once, however, plate B is hot it will become nearly as efficient as the light plate, so that it is desirable to use a light hot plate when a single operation has to be performed, whereas for continuous work a heavy plate is not a great disadvantage.

Hot plate A, which was constructed in our workshop, was of an extremely simple construction, consisting of a chrome-nickel wire in special glass beads about 1/16th inch in diameter, covering nearly the whole plate. The top was a thin cast-iron disc placed directly on the beads. The plate has been in daily use in my house for many months and has done excellent work. The average efficiency worked out at about 72 per cent., heating everything, including the vessel, from the cold state. The efficiency thus is very nearly as high as that of a vessel with the heating element in the bottom, or of a kettle.

---

* Abstract of paper read before the S.A. Inst. of Electrical Engineers.

In order to obtain a high efficiency it is essential that the vessel be in intimate contact with the hot plate. The surfaces of both must therefore be perfectly even, a result which can be assured only if the bottom of the vessel is fairly thick. For the comparison of hot plates, the testing vessel should have a bottom about one centimetre thick, in order to ensure good contact, and the surface should be carefully ground. For the ordinary household such vessels would be too expensive, and they are also unprocurable.

The energy consumption of the two plates was 850 and 1,766 watts for plates A and B respectively. When the quantity of water was increased to 4,000 grammes, the efficiency of the A plate was reduced to 66.4 per cent., that of the B plate was increased to 44.3 per cent. When the plates were once hot and used again immediately for boiling a similar quantity of water (2,250 grammes) for the second time, the efficiency of plate A was increased to 75 per cent., thus but little, whereas that of plate B rose to 66.8 per cent. These results show that the power consumption of plate A for larger quantities of water is too small, and that per litre of water it should not be less than 350 to 400 watts; in other words, that it pays to do the work quickly rather than have a small power consumption and long periods of waiting.

Another light hot plate, weighing 1¾ lb., with a top consisting of sheet aluminium, had an efficiency of 75 per cent., and this was increased by only two per cent. when the top was taken off and the vessel placed directly on the glass beads.

A hot plate of the heavy type often retains sufficient heat to produce the necessary washing-up water. In a carefully managed household a good deal of energy can be saved by making use of such heat. With the plate B above the efficiency can be increased by another 14 per cent. if water is placed at once in the previously used vessel on top of the hot plate.

Most hot plates cannot be left alone for any length of time without danger of destroying the heating wire, as the heating surface is too small for radiating all the energy absorbed. By making the top corrugated a foolproof kind of plate may be obtained. It can be used as an ordinary radiator, and with an aluminium top it is a very efficient hot plate at the same time.

6.—Grills.

A grill is a kind of hot plate with an open type of element. In the case of grilling meat the food is placed below the element and the heat, which rises upwards, is reflected by means of a reflector placed above the heating element.

For the making of pancakes with an ordinary iron frying pan, the grill is on the whole better than a hot plate, as the pan is mostly a little convex and would thus make but a poor contact with the top of the plate. In a grill type of hot plate made by Siemens the heating element consists of silit, described above. The efficiency worked out at 54 per cent. when boiling 2,250 grammes of water in the vessel used for the tests dealing with hot plates A and B. Another type of grill yielded similar results, the efficiency being 55.7 per cent. These figures relate to an aluminium vessel with a polished contact surface. When the bottom was painted the efficiency rose to 66.9 per cent. The dead black paint stops most of the reflection from the heated side of the vessel. With a highly reflecting whistling can on top of a grill the results of the painting were even more striking. The efficiency rose from 31 to 62 per cent. This clearly shows that all surfaces opposed to the heating element should be dead black, whereas the remainder of the vessel should be highly polished to reduce radiation as much as possible. But when vessels are painted a dead black, which are to be used in connection with the ordinary type of hot plate, the layer of paint acts as an insulator and the efficiency is reduced by a few per cent. For the making of pancakes the power absorbed by a grill should not be less than about 1,500 watts, to ensure a sharp heat, as slow frying makes the cakes leathery. Care should also be taken that the radiating surface of the grill is smaller than the area covered by the frying pan, so that little heat escapes. A reflector should always be placed below the element, and space should be provided below the reflector for placing the plates, so that the heat escaping that way warms up the plates. Or meat may be grilled below the element and boiling take place in a vessel with a painted bottom above.

7. Cooking Vessels.

A properly constructed aluminium cooking vessel has an efficiency of 80 to 90 per cent., and it is therefore the most efficient utensil on the market. Yet they are used but little, as they are not foolproof and burn out if the servant forgets to put the water in, or they are damaged if she washes the vessel by dipping the whole of it into the washing basin, unless the element is soldered up into the bottom of the vessel. In the case of aluminium, soldering is difficult and expensive. Yet such vessels are preferable to all others, as they require least labour. I have, therefore, endeavoured to design a vessel which embodies the advantage of the soldered-up type without having its disadvantages.

8. Kettles.

The remarks made under cooking vessels hold largely here. Efficiency and ease of repair should be aimed at. Aluminium yields the best results and requires least labour for cleaning. Nickel plated brass is very popular, and polished brass is also often used, though it requires daily cleaning. The efficiency of brass kettles does not exceed 80 per cent.

(To be continued.)

Tenders Accepted.—Orders have been booked by the Edison Swan Electric Co., Ltd., for 2,000 dry batteries for the War Office, and 1,500 plugs for the G.P.O.

School Magazine.—We have received issue No. 139 of the Crystal Palace Engineering School Magazine. It gives a full report of the inspiring address to the students delivered by Mr. Henry Adams on the occasion of the 154th certificate day last April, as well as an account of the annual dinner of the Old Students' Association, and various letters from old students in different parts of the world.

Questions and Answers by Practical Men.

RULES.

*Q*UESTIONS*: We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 186.

When viewing a cinematograph picture, the wheels of a carriage appeared to be turning backwards. Can any reader explain this to me?—" INQUISITIVE."

QUESTION NO. 187.

I wish to use a 100 volt., 3 amp. D.C. motor on 210 volts. Can any reader tell me how to construct a resistance to enable this to be done, since I am told that this is the most economical way of doing it?—" H. W. MAY."

(Replies to Questions Nos. 186 and 187 must be received not later than August 30, 1924.)

Answers to Questions.

QUESTION NO. 181.

I wish to make up a condenser for a home-made wireless set with mica and tin foil. Can any reader give me constructional details, *i.e.*, thickness of mica, quantity of tin foil, and precautions to be taken?—" E. J. MORTON."

The first prize (10s.) has been awarded to Mr. W. H. Thornburn, 11, Grimpthorpe Street, Headingley, Leeds, for the following reply:

E. J. Morton wishes to make a condenser of fixed capacity as distinct from the variable type with moving vanes.

I would strongly urge him not to use tinfoil for the purpose, owing to the difficulty in making reliable contact with the foil. A better material is thin sheet copper.

The capacity of a condenser is given by the formula

$$C \text{ mfds.} = \frac{a \times k}{4\pi \times t \times 900{,}000},$$

where a = area in sq. cms. of one set of plates or surfaces.
k = dielectric constant or s.i.c.
t = thickness of the dielectric in cms.

Note 1.—The effective number of plates is one less than the total number.

Note 2.—The s.i.c. of thin mica sheets is 6.7. The mica sold in wireless shops is usually stated to be .002" (.005 cm.), but this cannot be guaranteed. If "E. J. Morton" wishes to make a condenser of exact value, thin sheet ebonite is preferable for the dielectric as the desired thickness can be obtained with a fair degree of accuracy.

The s.i.c. of ebonite is 3.3.

For a condenser of approximately .004 mf. capacity, take—

1 piece of ebonite 5 cm. × 8 cm.
" " 5 cm. × 4.5 cm.
5 pieces of copper foil 2 cm. × 5 cm.
4 pieces of mica 2.5 cm. × 4.5 cm. × .005cm.

$$C = \frac{4 \times 2 \times 4 \times 6.7}{4 \times 3.14 \times .005 \times 900{,}000} = 0.004 \text{ mfd.}$$

To make the condenser. Place the two pieces of ebonite as shown in Sketch 1 and secure in a vice.

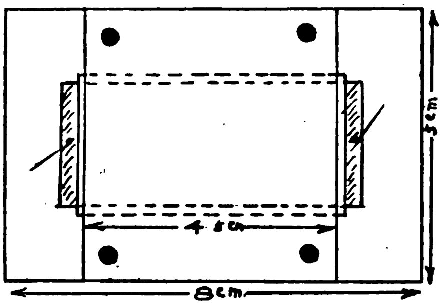


FIG. 1.

Drill 4 holes right through to a size suitable for any bolts and nuts on hand.

On the larger piece, place the copper foil and mica as follows:

One piece copper foil,
One piece mica,

alternately, until the four micas and five foils are in position.

The copper foils should overlap one another 4 cm. Foils 1, 3, 5, to the left, and foils 2 and 4 to the right, as shown in Sketch 2.

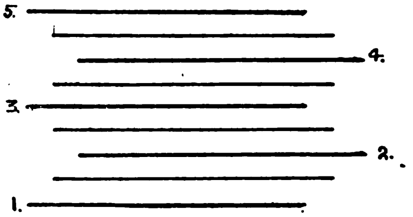


FIG. 2.

As each plate is added, it should be given a touch of shellac varnish to keep it in position, otherwise much difficulty will be experienced in keeping the foils and micas over one another, and the capacity would vary accordingly.

When all the plates are placed, the top piece of ebonite is carefully secured in position and the whole tightly fastened by means of the bolts and nuts. The projecting foils are now squeezed together at each end and either connected to terminals or soldered to wires.

The ebonite has been shown on the large size, but this has been done to avoid any risk of short circuit by the bolts.

From the above description, and the worked example, it will be an easy matter to design a condenser of any capacity, but for the larger sizes it will be cheaper to purchase.—" W. H. Thornburn."

The Second Prize Winner's reply will be published in due course.

Reviews of Books, &c.

[*Books noticed in this column will be sent from* Electricity *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.*]

British Oil Engines. By W. A. Tookey, M.I.Mech.E 176 pp. (Percival Marshall, 2s. 6d. net.)—This is a very useful little book and a valuable addition to that class of literature which is designed to impart knowledge and information of a reliable character on the subject with which it deals, in a simple and easily intelligible form, to the man who is not an advanced scholar or well versed in the technicalities which are often introduced into works of this type. It is, in fact, just the kind of book to put into the hands of any person who may have to select or erect an oil engine for any specific purpose, and, having such an engine under his care and control, to guide him in connection with the management of its operation, and to give information in connection with little difficulties or troubles that may arise, as well as the means to be adopted in order to avoid and to correct such incidents. Its application may be said to refer to liquid-fuel engines of all classes. The author, who is well known as a writer in connection with internal combustion engines, and whose publications have been often referred to during the last twenty years, has followed closely the great developments which have been brought about during that period, and which have been of a wonderfully expansive nature. The book gives highly important and interesting results of tests of most of the well-known modern productions by various makers, and comparative details, which will be found most useful and illuminating. There are ten chapters altogether, and sufficient illustrations to make clear the principal features referred to. The two last chapters on management of oil engines and hints to attendants are particularly noticeable and to be commended to the attention of all who have the duty to look after or care for an oil engine for whatever purpose it is used, but especially so in connection with engines used for driving dynamos for the generation of electricity.

Electrical Measuring Instruments. By C. V. Drysdale and A. C. Jolley. Part I.: Commercial and Indicating Instruments. Cr. 4to, 440 pp., 377 illustrations. (Ernest Benn, 55s. net.)—We have no hesitation in saying that in our opinion the book now before us will be looked upon as a classic on the subject of electrical instruments for several years to come, and, indeed, until inventive science has made very material advances beyond present-day practice. As a matter of fact we do not agree with the authors in their preface when they apologise for issuing the work and say that so many have already been issued. Considering the years during which the supply and use of electricity have been important items in the commercial life of the country, we think the number of good text books on electrical measuring instruments is remarkably few, and we welcome the newcomer all the more heartily. The arrangement is excellent. The opening chapters deal with general electrical principles, mechanical design and indication essentials, all of which are illustrated with a wealth of diagrams and curves, after which we are conducted through lucidly written sections on electrical theory and design and the properties of electrical materials. Chapters VI. to X. deal with the actual instruments of the different types now on the market, and in this connection the authors are thoroughly cosmopolitan. They deal clearly and at length with all makes so far as lies in their power. English, French, German, American, Swiss, all are included, and detailed information is given regarding their construction and performance, and the labour involved in preparing the data given in the book must indeed have been immense. Certainly it is a work of the utmost importance to all manufacturers of electrical instruments, to the actual users such as central station engineers, etc., and to every electrical engineering student. We shall look forward with keen interest to the arrival of Volume II., which is to deal with laboratory and kindred instruments. Meantime, Vol. I. has a very hearty welcome.

Various Items.

Tenders Accepted.—The G.P.O. have accepted the tender of the Edison Swan Electric Co., Ltd., for the supply of 25,000 No. 1 Leclanche porous cells.

Sweden.—The current issue of the *Swedish Economic Review*, which has just been published, contains a general survey of business conditions in Sweden, as well as a review of the staple industries.

Finance.—The directors of the Charing Cross E.S. Co., Ltd., have declared an interim dividend of 1s. 3d. per share on the ordinary shares of the West End Undertakings for the half-year ended June 30.

New Edition.—The sixth edition of the "Platelayers' Guide" will be ready for issue during next month Orders are now being booked, on receipt of remittance, at the rate of 7s. 6d. per copy. As the edition is limited, early application is desirable if copies are required.

Wireless Apparatus in Argentina.—A confidential report on the market for wireless apparatus in Argentina has been prepared by the D.O.T., and U.K. firms desirous of receiving a copy should communicate with the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

Motor Shipbuilding.—Some very interesting figures regarding the present position of British and foreign motor shipbuilding are published in the current issue of *The Motor Ship*, and in addition to articles describing new motor-ships, which have recently been launched, there is an interesting chapter on auxiliary machinery which will appeal to electrical engineers.

A New Steel Furnace.—Messrs. Vickers have just installed at their Barrow-in-Furness works a new open-hearth Siemens steel furnace of the very latest type, built and designed by Wincott's, of Sheffield. The capacity is between 10 and 20 tons per heat, and it is now possible to get a total output from the steel foundries at the Vickers Barrow works up to 300 tons of castings per week, ranging from a few pounds' weight each to a 20-ton casting.

Norway.—The report on the industrial conditions in Norway has just been issued by the D.O.T., and may be obtained from H.M. Stationery Office or Electricity office, price 2s. 2d. net, post free. In it there are certain sections of interest to British electrical engineering firms, namely, those dealing with water power, Government power schemes, and the export of hydro electrical power. Also there are paragraphs on the subjects of electrical machinery and insulated cables.

Wolverhampton.—Congratulations to Mr. S. T. Allen, M.I.E.E., Borough Electrical Engineer, on the very successful working of the borough electrical undertaking for the year ended March 31. As mentioned in the annual statement, the results do most certainly reflect the soundness of the policy adopted and the excellent management of the engineer. The net profit amounts to £25,557, of which £10,000 is to be contributed towards the relief of the rates. It is to be noted that the heating and cooking load has developed rapidly, and there are distinct indications that the advantages obtainable from electrical appliances for domestic service are becoming much more widely appreciated. We have every confidence that a continuance of the present management and policy will lead to still further reductions in the cost in the near future, combined with a continuance of the profit balance.

For Prompt Attention.—We expect nearly every reader of this paper is interested in the new wiring rules of the I.E.E., and we advise them to obtain copies without delay. The price is 1s. 2d. post free from ELECTRICITY Office, or if you send 1s. 5d. we will also enclose a copy of the wiring rules which have hitherto been used by the Phœnix Fire Office. They are interesting from the point of view of comparison.

Spain.—The report on the industries and commerce of Spain has just been issued by the D.O.T. and may be obtained from H.M. Stationery Office or ELECTRICITY office, price 2s. 9d. net, post free. In it there are certain sections of interest to English firms who contract for the supply of electric railway material as well as the export electrical industry in general. The industrial crisis has been acute, but conditions are improving slowly.

S.S. "Dearne."—The screw steamer *Dearne,* which is a first-class cargo and passenger boat built by Vickers, Ltd., Barrow-in-Furness, for the L.M. and S.R. Co.'s Goole and Continental service of passenger, cargo and horse-carrying steamers, was launched on the 31st ult. A complete system of electric light is fitted throughout the ship, with clusters for cargo working purposes, a generator of 10 k.w. being provided for supplying the necessary current.

Tenders Accepted.—The Vickers Spearing Boiler Co., Ltd., of 20, Kingsway, W.C.2, have secured a large contract with the St. Pancras Borough Council for a complete boiler-house plant, including pulverised fuel plant equipment for their electricity works.——The tender of the Siemens and English Electric Lamp Co., Ltd., has been accepted by the Bedwas Navigation Colliery Co. (1921), Ltd., for the supply of Siemens gasfilled lamps as and from the 1st inst. to the end of the year.

Italian-South American Cable.—We understand that Messrs. Siemens Bros. and Co., Ltd., of Woolwich, have secured contracts for the manufacture and laying of about 3,200 miles of submarine telegraph cable to connect the Cape Verde Islands with Rio de Janeiro, touching at the island of Fernando Noronha, off the northern coast of Brazil. The first section is to be completed by the end of January, 1925, and the whole scheme should be in working order by the end of May, 1925.

Quotations Wanted.—The P.M.G.'s Dept., Melbourne, are calling for tenders for switchboard cords.——The Johannesburg Municipal Council are calling for tenders for 42 current transformers.——The Rand Water Board invite tenders for two centrifugal pumps and motors.——The State Electric Supply Works at Montevideo are calling for tenders for the supply and delivery of 60,000 metallic and carbon filament lamps.—Specifications, etc., from the D.O.T. (Room 52), 35, Old Queen Street, London, S.W.1.

The Wireless Exhibition.—We have received from the National Association of Radio Manufacturers a reproduction in colour of the decorative scheme which is to be adopted at the All-British Wireless Exhibition, due to be held at the Royal Albert Hall from September 27 to October 8 inclusive. It is certainly a very effective design, and when the Exhibition is completed in accordance therewith it should prove a most attractive centre, which will undoubtedly be attended by all wireless enthusiasts in London and the provinces who can possibly manage to get there.

The "Stannos" System of Electric Wiring.—Pamphlet 130A, which has just been issued by Siemens, Brothers and Co., Ltd., of Woolwich, contains a number of illustrations of buildings wired on the "Stannos" system, from the humble cottage to the lordly castle and the stately abbey. The different classes of buildings are grouped together, and are surrounded with appropriate artistic sketches. In one or two instances these sketches depict actual incidents that have occurred in the history of the buildings they encompass. "Stannos" wire consists of an insulated conductor contained in a tinned copper sheathing, which latter also acts as a mechanical protection. The wire is semi-flexible, clean to handle, quickly erected, and inconspicuous where exposed.

Large Telephone Exchange Batteries.—The D.P. Battery Co., Ltd., has just received orders from Messrs. Newton Bros., Ltd., of Derby, for two batteries for the Telephone Exchanges at Gloucester and Newport, the capacity in both cases being 4,993 ampere-hours at the 9-hour rate. Provision will be made so that the capacity of these batteries may be increased to 9,986 ampere-hours and 8,812 ampere-hours respectively. In addition to the large batteries, two smaller ones, each consisting of 150 cells, are also required for these Exchanges. The company has further orders in hand at the present time for P.O. Exchanges at Birkenhead, Aldeborough, Didsbury, Trafford Park, Leeds, Cardiff, etc., in addition to which it is also enlarging batteries at Liverpool, where the cells will have a capacity of 5,105 ampere-hours at the 9-hour rate of discharge.

Trade Notes.

The August monthly price-list has been issued by the **Siemens and English Electric Lamp Co., Ltd.**, of 39, Upper Thames Street, London, E.C.4, and any installation contractor or dealer who has not yet received a copy should make a point of writing and asking for it without delay. It is always of use to the trade.

Sheets BX, X and K, which have just been issued by **Messrs. Capel and Co.**, engineers, of Dalston Lane, London, E.8, deal with the latest types of their "Excelite" electric generating plant, both belt and direct-driven, and as such should appeal to installation contractors and engineers who lay themselves out to fit these small installations into country houses, factories, etc. The lists are well worth writing for.

A new issue of the "Buff Book," the London Trade and Commercial Directory, issued with the authority and co-operation of the P.M.G., is in course of preparation, and will be ready in October next. A copy is delivered free by the post-office to all subscribers to the London Telephone System. Any firms, therefore, who wish to insert special entries and announcements in the next edition should communicate immediately with the publishers, the **Business Telephone Directories, Ltd.**, 25, Lawrence Lane, E.C.2.

Folder R7440B, just issued by the **B.T.-H. Co., Ltd.**, of Rugby, deals with their latest R type radio valve, for rectification and amplification. It is claimed that it is very effective in action, and works well either as a detector or amplifier. The folder should interest all dealers in wireless supplies, and copies will be supplied on application.

List No. 431, from **George Ellison**, of Perry Barr, Birmingham, gives in its 20 pages illustrations and details of the latest types of cable fittings, pipe flanges, clamps and glands made by the firm for central station and industrial apparatus, all of which should be of direct interest to electrical engineers who are associated with this particular class of installation work. Weights and dimensions are given as well as prices, and altogether the list is very comprehensive, and we hope to give illustrated details of certain items in a later issue.

From the **London Hydraulic Power Co.**, of Hatfield Street, Southwark, S.E.1, we have received a map of London showing the mains worked by them under their hydraulic system throughout the leading districts. It shows the important work which is carried out by them in an unobstrusive and at the same time eminently satisfactory manner.

Catalogue 71, dealing with electric bells, buzzers, indicators, pushes, etc., has been issued by the **Siemens and English Electric Lamp Co., Ltd.**, of 38, Upper Thames Street, London, E.C.4, and should appeal to all bell fitters and installation contractors, as well as to factors and dealers in electrical supplies generally.

The **Foster Engineering Co., Ltd.**, of Wimbledon, are issuing a circular about the Foster Crown Cables, for which they claim that their first-class material, low prices and quick delivery have been rewarded by big sales. The circular is accompanied by a useful blotter advertising their "Apex" Ironclad Switch and Fuse Gear.

Success often consists almost wholly in not doing the wrong things.

Sample Pair Sent on Approval for 8/6

Made of Pure Para Rubber, soft and durable and unaffected by climatic conditions.
DAVID MOSELEY & SONS,
Limited,
ARDWICK MANCHESTER.

MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
A PRACTICAL TRADE JOURNAL

AUGUST 15, 1924

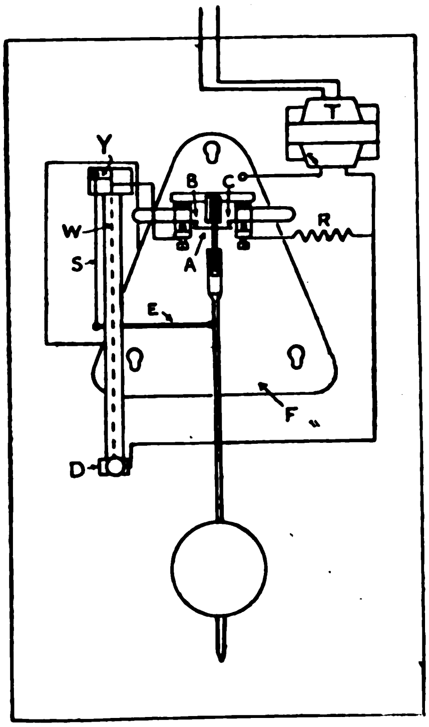
CONTENTS. PAGE
A New Type of Electric Clock 419
New Leakproof Sleeve Bearing for Electric Motors 420
How Metal Wires are Sealed to Glass 420
Light and Colour 421
Telegraphy 422
Quickways Electric Cooker 422
Current Topics 425
The Electrical Kitchen for Private Houses 426
Questions and Answers by Practical Men 428
New Cable Fittings 431
The "Valley" Battery Charger 431
A New American Electric Furnace 432
Various Items 434

A NEW TYPE OF ELECTRIC CLOCK.

The Zenith electric clock, made by the Fabrique des Montres Zenith, of Le Locle, Switzerland, affords a new and unexpected application of the hot-wire principle. The alternate expansion and contraction of a wire which carries current intermittently is used to maintain the oscillations of a pendulum, the latter controlling the actual clock movement in the usual way. The clock is thus of the individual or self-acting type, in which the electric current takes the place of a spring motor or weight, but, unlike most of the other electric clocks of this type, the Zenith hot-wire clock requires no batteries or accumulators, and contains no operating coils or magnets. As will be understood from the subjoined description, the new clock is simple and rugged in construction, inexpensive in first cost and in maintenance, and is actuated from the ordinary lighting supply.

Referring to the accompanying diagram, the supply leads at 100 to 250 volts, A.C., are connected to the step-down transformer *T*, which is required to deliver .25 amp. at 3 volts on the secondary side. Where direct current supply is alone available, the transformer is replaced by a suitable resistance, but this arrangement is, of course, less efficient. Neglecting losses in the transformer, .25 amp. at 3 volts on the secondary side corresponds to 3.4 milliamps. at 220 volts on the primary side; few, if any, supply meters will record this small consumption—a fact which is not likely to please the central station engineer, particularly as there is also the wattless magnetising current of the transformer to be considered! On direct current supply, the current required in the hot wire would presumably still be .25 amp., in which case the power consumption appears to be rather a serious item, for .25 amp. at 100 volts equals 25 watts, and, at 220 volts, equals 55 watts. From the information before us it certainly seems that the economic practicability of the clock is restricted to places where A.C. supply is available.

Resuming our description of the action of the clock, one of the secondary terminals of *T* is connected to the frame of the clock, and so, through the suspension, to the contact pin *A*. This pin, when the pendulum is central, makes contact with both the contacts *B* and *C*, and thus allows current to flow in parallel through the hot wire *W* and the resistance *R* back to the other terminal of the transformer. The bottom of the wire *W* is attached to a clamping block *D*, and the upper end is secured to a pivoted yoke *Y*; the latter carries a spring wire *S*, which is connected to the pendulum by a silk cord *E*.



Suppose now that the pendulum be drawn to the left by hand and released. When the pendulum bob is to the left, the contact *B* remains closed, but contact *C* is opened, and the whole of the current from the transformer therefore passes through *W* and causes it to expand. Through the movement of the yoke *Y*, the lower end of *S* is thus moved to the right, and the cord *E* is slackened, allowing the pendulum to swing to the right. The contact *C* is thus closed and *B* is opened. Current no longer flows through *W*, and this wire (which is only 0.1 mm. diameter) therefore cools quickly, contracts, and pulls the pendulum back by the cord *E*. The pendulum then swings to the left and the cycle is repeated. The clock movement itself is a separate piece of mechanism; it is mounted on the plate *F* by three pillars which engage in the slotted holes shown, and it is driven by the pendulum through an elastic arm.

The object of having the second contact *C* and the resistance *R* is to prevent sparking at the contacts. Both contacts *B* and *C* are closed momentarily at the centres of the swing, and current is transferred from *W* to *R*, and *vice versa* without sparking. If desired, *R* may be replaced by the motor wire of a second clock, which would then operate as a "slave" and would have no contacts of its own.

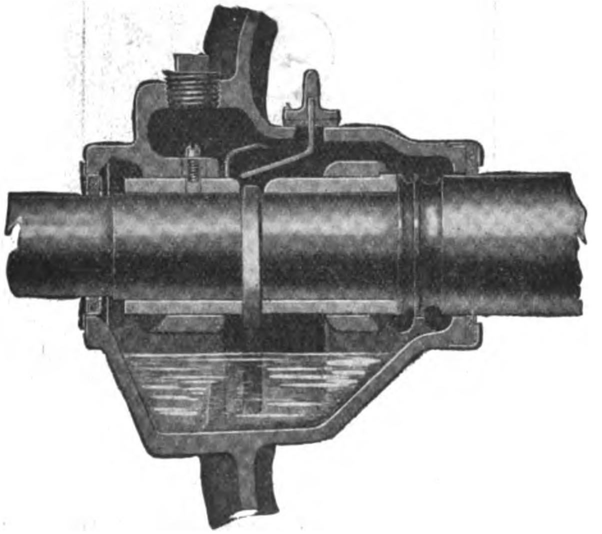
A possibility which will at once occur to the reader is that of the clock stopping in the event of failure of electric supply. To avoid this the clock may be fitted with a "power reserve," *i.e.*, a spring barrel which is kept wound by the pendulum, the latter being operated as before by the alternate expansion and contraction of a hot wire. The reserve power thus provided will keep the clock going for 30 hours without electric supply, and interruptions of such duration rarely, if ever, occur in the public supply systems of to-day.

Without attempting to express any horological opinion, which would be outside our province, the Zenith electric clock represents a new and most ingenious application of the hot-wire principle, which has already found so many useful applications in electrical work.

NEW LEAKPROOF SLEEVE BEARING FOR ELECTRIC MOTORS.

A new type of sleeve bearing for electric motors, designed to prevent the leakage of oil into the windings, or the entrance of dust and grit into the bearing, has been developed by the Westinghouse Co., of U.S.A. This new bearing, which is known as the Sealed-Sleeve bearing, is so constructed that it is almost air-tight, preventing air from getting in and oil from leaking out.

The principal methods used to improve the conventional bearing are comparatively simple. A connecting passage in the upper part of the bearing housing secures a condition of balanced **air** pressure in the separate chambers into which the housing is divided by the bearing supports. The action of the blower at high speeds sets up a vacuum next to the inside end of the housing and, since it is impossible to seal the housing absolutely at that point because the shaft passes out there, the vacuum is communicated to the space within the housing itself. If the upper passage were not provided, an unbalanced air pressure would result whenever the oil level rose high enough to close the lower cored openings.



THE SEALED-SLEEVE MOTOR BEARING,
Showing how effectively this bearing is sealed against the entrance of air or dust and prevents the leakage of oil or oily vapour into the motor.

For inspection of the oil ring, a large air-tight threaded pipe plug is provided. An enclosed combination filling and overflow opening is placed in the side of the bearing and a rigid cast iron cover is bolted over the oil ring slot and made airtight by an oilproof packing.

Where the shaft passes through the bearing, an improved method of supporting the felt dustproofing washer is used. For the purpose of lending resilience to the soft felt, the metal cap has a diameter at least ¼ in. larger than the shaft diameter. This prevents the felt from being compressed close to the shaft, which would cause it to become glazed and hardened and to soon burn and wear out. Since it is left free to expand, it acts like a brush and does not mar or glaze.

The air-tight construction of the bearing prevents the passage of air through the bearing and at the same time prevents oil from being drawn into the motor windings. The oil ring, carrying oil from the oil well to the motor shaft, stirs up and churns the oil into a fine spray, which, in the ordinary type of bearing, is sucked into the motor and covers the windings. The sealed-sleeve bearing is sealed so thoroughly that the escape of oil from the bearing is prevented.

The manner in which the bearing is sealed against the entrance of air makes it immune to most conditions of dirt, dust and grit. No gritty substances can enter to mix with the lubricating oil and cause wear of the bearing shell or shaft. Clean oil is always supplied to the bearing, and the life of the lubricating oil is determined not by the amount of impurities it contains, but by its breakdown as a lubricating medium.

By absolutely preventing oil leakage, the sealed-sleeve bearing prevents weakening of the motor insulation by the lubricating oil and the resultant grounds and short circuits, which frequently result in delays and expensive repairs.

The bearing requires practically no attention, and oiling once or twice a year is generally all that is necessary.

HOW METAL WIRES ARE SEALED TO GLASS.

SOME NEW INFORMATION ON THE LESSER-KNOWN SUBJECT OF BULB AND VALVE MANUFACTURE.

The discovery of the incandescent lamp and the use of vacuum wireless valves have brought in their train certain difficulties in connection with the passage of the metal wire electrodes through the glass of the bulbs, whilst ensuring a perfectly air-tight joint. It is well known that the more common inexpensive metals have a higher degree of expansion for a given temperature rise than glass has, so that, if a piece of such metal be inserted into molten glass, it will quickly assume the temperature of the glass, but will contract more on cooling, due to its greater expansion coefficient, so that it will actually occupy a smaller volume than the glass, and this will prevent an air-tight joint from being made. Let us consider a few specific instances in order to illustrate the difficulty of the sealing process.

The metals mentioned have expansion coefficients proportional to the following values: Copper 16.7, iron 11.9, silver 18.8, nickel 12.8, platinum 8.9. The common forms of glass used in incandescent bulb and valve manufacture have expansion coefficients of from 7.5 to 9.0.

WHY PLATINUM IS THE BEST METAL.

Examining these values, it will be seen that, with the exception of platinum, none of the common electrical conductor metals mentioned has a sufficiently low coefficient to enable it to expand and contract with rise and fall of temperature at the same rate as glass. It is not possible, therefore, to use solid wires of these metals for electrodes with ordinary glass. For many years fine platinum wires were fused into the bases of lead glass bulbs, and were quite satisfactory, but expensive. The growth of the demand for platinum, together with the increase of size and the different shapes and varieties of metal parts in electrical devices, has rendered its use prohibitive on account of its cost. As we have seen, it is not possible to use round rods or wires of copper, silver, nickel or iron; neither is aluminium suitable, for its expansion coefficient is proportional to the value 25.5. With nickel and iron, having values of 12.8 and 11.9 respectively, and a special glass of 9.7, an approach to the desired conditions is obtained; but even with these the very slight separation, after fusing the wires into the glass, on cooling down would be sufficient to destroy the vacuum inside the bulb.

MODERN ALTERNATIVES TO PLATINUM.

For incandescent lamp electrodes the metal *tungsten* is now extensively used, since it has approximately the same expansion coefficient as Pyrex glass, and a good seal can be made between them. Tungsten wire is, however, expensive, and this fact has led to the investigation of other methods and materials.

As a result it has been found that copper in the form of a very thin flat strip, such as would be formed by hammering round wire flat, can be sealed effectively to, and through, glass so as to give a vacuum-tight joint. It is necessary to coat the copper with borax before sealing it into the glass, in order to prevent oxidation of the copper. Not only can small copper strips be thus fused into glass, but relatively large flattened copper wires, and even copper foil, can be used successfully. One condition found to be necessary when using copper strip was that the edges should be very sharp, similar to a knife-edge; the ordinary rectangular section is not always satisfactory. It is not possible to seal effectively, and without the use of borax, relatively large copper strips with knife edges to glass.

RECENT EXPERIENCES.

A considerable amount of investigation and research work on the subject has been carried out by the Western Electric Company, from both the chemical and mathematical sides, with the result that the principles are now fairly well known, and metal sealing, hitherto believed to be impossible, is now a *fait accompli*.

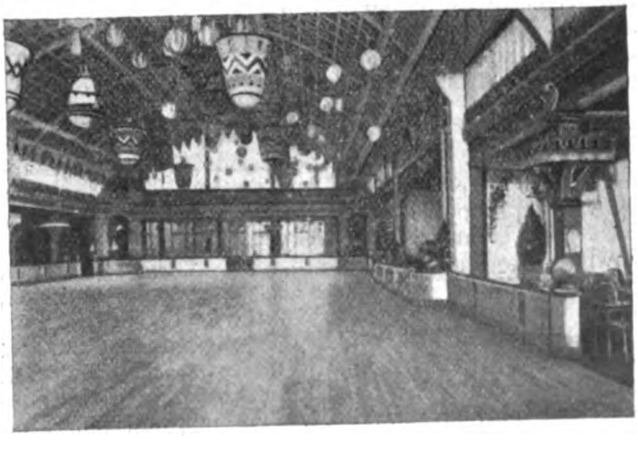
It has been shown that the adhesion of the glass to the copper is independent of the thickness of either of these materials; but, on the other hand, the stresses which the joint may be called upon to resist are directly dependent upon the thickness of either or of both. Whilst it has been shown to be possible to make an almost perfect seal, from the lamp manufacturer's point of view, of a thin section of either to a thick block of the other material, yet it is not possible to seal a heavy block of the one to a heavy block of the other.

The progress which has recently been made is a result of a step-by-step development in the research laboratory, and there now appears to be no limit to the size of the seals which can be made between certain of the inexpensive conducting metals used in electrical work and glass, so long as the parts are properly designed or proportioned, and are not too large or bulky to be handled properly during the fusing process.

LIGHT AND COLOUR.

The annexed illustrations show two phases of the illuminating value of incandescent lamps. In the one case white gasfilled Osrams are used for lighting the interior of a hairdresser's shop, for which they have several distinct advantages, not the least being that the customer with his head thrown back does not have to gaze with irritation at a bright bare filament, while the hairdresser avoids the discomfort of specular reflection from razor and scissors, which is extremely hurtful when continued during the long hours of artificial lighting usually incurred in this particular trade. In our second example, which shows the interior of the Regent Dance Hall at Brighton, the prevailing idea is

THE CHEERFUL BARBER.



THE REGENT DANCE HALL, BRIGHTON.

to obtain colour combined with brightness and novelty, and for this some really excellent decorative effects have been produced by means of gasfilled colour-sprayed lamps of the same well-known make. In all, many thousands of them have been installed, of which more than 1,200 hang in festoons from the ceiling. For this installation the very effective results are due to Mr. C. E. Nichols, chief engineer to the Provincial Cinematograph Theatres, who are the owners of the hall.

TELEGRAPHY.*

Being solutions to the questions set at the Grade I. examination in Telegraphy held by the City and Guilds of London Institute, on April 30, 1924.

(*Continued from page* 410.)

Q.—Describe, with a diagram, one system of central battery duplex working. What are the relative advantages and disadvantages of the method described as compared with ordinary double current duplex?

A.—The following is a description of the Vyle and Smart central battery duplex system of telegraphy :—

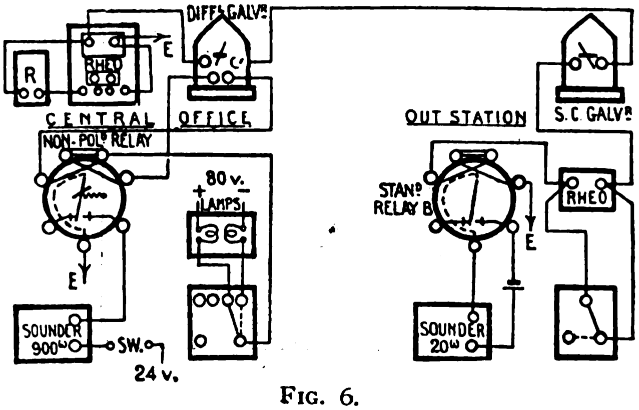


FIG. 6.

At the central office a 6-terminal reversing key is used, adjusted to give equal play on the top and bottom contacts and to short-circuit momentarily the battery.

To balance the circuit, the resistance in the compensation circuit is adjusted to give a deflection of about 45 degrees to the right on the differential galvanometer. The key at the out station is then depressed and resistance is unplugged in the rheostat at that station until the needle of the differential galvanometer at the head office points to zero. The static balance is obtained when the out station key is depressed and the needle of the central office galvanometer points to zero.

Normally the current in the line exceeds that in the compensation circuit. This preponderance of current in the line coil of the non-polarised relay opposes the tension of the spring, and the tongue is held against the spacing stop, this being the case whether the central office key is at rest or depressed. The line current flowing through the standard relay at the out station produces a mark or a space according to its direction, which direction is controlled by the head office key.

When the out-station key is depressed the short circuit round the rheostat at that station is removed, and the currents flowing on the windings of the non-polarised relay are equalised. The magnetic effect on the armature is therefore *nil*, and the spring pulls the tongue over to the marking stop.

When both keys are depressed simultaneously, the spring asserts itself, and produces a mark on the non-polarised relay, while the current flowing in the line coil of the standard relay (out station) produces a mark in the same way as when the central station key is depressed alone.

The local circuits are joined up in the usual way, with the exception that a tumbler switch is connected in circuit at the central station for the purpose of switching off the battery when the circuit is not in use.

The advantages of the Vyle and Smart central battery system over the ordinary double current duplex system are :—

(1) Line battery not required at out station.
(2) Greater simplicity of apparatus at out station.
(3) No duplex balance is required at out station.

A disadvantage is that overhead lines cannot be worked so satisfactorily over long distances as can the double current duplex system.

(*To be continued.*)

QUICKWAYS ELECTRIC COOKER.

For some time now Messrs. Quickways, Ltd., of 107, Pimlico Road, S.W.1, have had on the market a speciality of theirs called the Quickfri Magic Cooking Pan, which has been used on gas stoves.

On the 29th ult. they gave the electrical Press the opportunity of going down to their London showroom to view their latest addition—a Quickfri Cooking Pan electrically heated. They had experimented with this form of pan on a warm plate, but it was not satisfactory, and they have now produced a complete cooker with the heating unit enclosed. The pan is made in a variety of sizes, the most useful being about 12 in. diameter. The sides are lined with asbestos board and the bottom packed with asbestos fibre and silicated wool. Fixed in the bottom is a coil supplied with current at suitable voltages.

This cooker works on the boiling oil principle, and the pan fitting in over the coil is about three-quarters full of lard or some similar fat. When the current is turned on this melts, and in about a quarter of an hour reaches boiling point. As soon as that happens cooking may be commenced. Full course dinners may be cooked by this process in a phenomenally short time—a complete chicken taking only 8½ minutes, and tasting far more delicious than when cooked by any other method.

The wire basket strainer fitted into the bottom of the pan enables food to be removed quickly and to drain off superfluous fat. Everything can be cooked in the one saucepan at the same time if there is room, as the flavour from one form of food is not passed to anything else, and apple fritters, onions and cheese cakes cooked together all come out tasting delicious and showing no effects of their close proximity.

This fryer has passed the experimental tests quite successfully and will soon be put on the market. It is a thing that is growing immensely in popular favour, and should prove an excellent selling line for the electrical retailer.

The **London Electric Wire Co., and Smiths, Ltd.**, have published a revision of section two of their general catalogue issued in March, 1923. The revised section now includes cab tyre sheathed cable, and a comprehensive stock of this type of cable is being carried at the works and offices at Playhouse Yard, Golden Lane, London, E.C.1. Trade readers who have the original catalogue should make a point of asking for the revised section if they have not already had it sent to them.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of
CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N. 17.

TO OUR READERS.

Electricity is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application, Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. Rentell and Co., Ltd., 36-39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

Wolf! Wolf!

Judging by the attendance at the British Empire Exhibition on August Bank Holiday, the efficacy of the old fable anent the too frequent crying of "Wolf!" has once more asserted itself. Our lay Press, suffering from over-zeal, had assiduously published paragraphs anticipating an unprecedented and record crowd at Wembley on the Monday. As a very natural result, the public, anticipating an uncomfortable crush, stayed away, and there were actually less gate receipts than on a normal Saturday. Indeed, the Tuesday attendance beat that on Bank Holiday, and the subsequent attendances during the last holiday week have been well up to the standard. The incident recalls a similar scare during the war period, when everybody was warned that the holiday traffic on the railways would beat all records, and that it behoved them to arrive early at the stations and avoid the crush. As a consequence, practically nobody ventured afield, and it was one of the most comfortable days for travelling that the restricted war services afforded.

One can have too much of a good thing, and this appears to be an example of the abuse of propaganda. The average man hates a crowd, and endeavours to avoid the discomfort whenever possible. Apropos ill-considered propaganda, I see that the daily Press are referring to friction at Wembley between exhibitors and the administration over the alleged early closing of stands. There may be friction, but, if so, it does not concern the public, and there is nothing to be gained by washing dirty linen in public. This sort of thing does the Exhibition no good, but rather prejudices public opinion, and does not encourage attendances. Whatever the trouble—and there are probably faults on both sides—the matter concerns the principal parties only; let it rest at that. Some reporters possess very little tact or discretion; nor are sub-editors wholly free from blame. For example, there was the "scoop" report of the 8 a.m. opening of the Exhibition on Bank Holiday. That published statement was entirely unauthorised, and caused endless trouble to the officials responsible for the safety of the various exhibits. Moreover, it was totally unnecessary, as there was no crush at the turnstiles.

F.B.E.E.

The Fellowship of the British Empire Exhibition, of which His Royal Highness the Prince of Wales is president, was founded with the idea of making more permanent the work of the Exhibition in impressing upon the people of our Empire the richness and completeness of its resources. Groups of Fellows have now been established in every part of the Empire, and, in order to extend the facilities for membership to a larger circle of interested people, an Associate Branch has been established at a subscription of 5s. This very nominal sum assures to each Associate a certificate signed by the Prince of Wales and a handsome badge as a souvenir of the Exhibition, in addition to two tickets of admission. A proportion of the subscription is also used for founding Empire scholarships. With this incentive, it behoves every interested reader to enrol as an Associate, and so help the good cause of Empire Fellowship. Applications, accompanied by remittance, should be addressed to 16, Grosvenor Gardens, London, S.W.1.

"Electricity in Service."

Gallant and energetic little E.D.A. is still performing wonders at Wembley in educating the public up to the domestic and industrial possibilities of electricity. Ever since the opening of the Exhibition, the E.D.A. exhibits have proved important centres of interest, and small crowds surround the various stands and parade the corridor of the Electric House all day long. The activities of E.D.A. now include a course of practical instruction in electric cookery given by one or two very able lady lecturers on the subject. It is estimated that some 10,000 visitors inspect the exhibits daily, and at least 50 per cent. are sufficiently interested to ask for further information from the attendants. The E.D.A. staff is made up of representatives of many supply undertakings up and down the country, and of others possessing showroom experience. The very close interest taken in these exhibits by the Royal Family has undoubtedly acted as a stimulus.

At the time of writing the various E.D.A. exhibits have been visited by their Majesties the King and Queen, their Royal Highnesses the Duke and Duchess of York, Prince Arthur of Connaught, Prince Henry, and Princess Charlotte. Deputations and representatives have also visited the displays on behalf of certain industrial and commercial undertakings interested in electrical machinery for catering, laundry work and industrial processes to which the method is more or less new. With E.D.A. performing such invaluable service at the consumer's end of the mains, we now want an equally active and influential organisation to devote its energy to bring about a general reduction in the price of the unit. Something on the lines of the old "Point Fives" could find an excellent field for its activities among the many moribund undertakings, which do not display any tendency to march with the times and cater for the demand which other sections of the industry are working so hard to create. It is of little use preaching the gospel of domestic electric service if the average unit costs anything from sixpence upwards; it is simply love's labour lost.

Making v. Selling.

Speaking at the recent Advertising Convention, Sir Charles Higham said he did not think we produced too many goods, but we had to learn how to sell them. We were masters of export in this country, and could teach others a lot in that matter, but we had much to learn from the United States in respect of popularising what we produced. We were too prone to stick to our own last, and in business matters mind our own business. This was a matter in which we should not mind our own business so much. Advertising was the electricity of business. Without it things would stagnate. Magnificent as it was, the Wembley Exhibition had failed, in his judgment, because we had not told the world what was in it. Labour could learn a great deal from attending the Convention, because, much as Labour knew about making things, it knew little about selling them. If they could teach Labour men that the greatest problem was selling things and not making them, they would not have worked in vain. This very telling speech serves to accentuate my recent remarks concerning the so-called "workers" and the middle classes, many of whom are engaged on the often extremely difficult task of selling.

"Some" Boiler.

According to the *Times of India*, electrically heated boilers are unknown, but one absorbing 18,000 kilowatts, recently built in America, is probably the biggest yet constructed. The working voltage is 22,000, three-phase current being utilised. It is stated that the boiler has an output of about 50,000 lb. of steam per hour at 135 lb. per square inch. The boiler is, of course, not used for raising steam for driving steam engines, but is employed in a chemical works where the steam is utilised for various other purposes. The boiler is in three cylindrical sections, 7 ft. in diameter and about the same height, the floor space occupied being over 25 ft. by 8 ft.

Antiques in London Streets.

According to *Municipal Engineering*, Londoners frequently grumble at the ancient standards which are still to be found in many London thoroughfares. Some of these are over a hundred years old. On the other hand, in the eyes of visitors from the other side of the Atlantic these relics of the past evidently possess a considerable value. A surveyor to a Metropolitan borough council had evidence of this recently. He was approached by an American with the request that he would name his price for a number of standards in a West End thoroughfare, as he was anxious to convey them to, and instal them in, his native town in some distant State, where antiquities are as rare as they are appreciated. This probably accounts for the periodical disappearance of salt spoons and other readily portable objects from the tables of some of our most notable restaurants during the current American invasion. These also will doubtless find their way to Dixie or some other equally salubrious clime, where they will figure as souvenirs of that great European tour.

ELEKTRON.

THE ELECTRICAL KITCHEN FOR PRIVATE HOUSES.*

By PROF. H. BOHLE, M.I.E.E.

(*Continued from page* 415).

9. REGULATIONS FOR THE MANUFACTURE OF COOKING VESSELS.

A great deal of the non-success of electric cooking is probably due to the haphazard manner in which electric utensils have been manufactured and rated. The loading of the heating wire is mostly excessive, leaving too little margin for voltage variations and the thoughtlessness of servants. If electric cooking is to become a real success, stringent though reasonable regulations will have to be adopted for the manufacture of these articles. Standard regulations should be drawn up by the institutions concerned, and should be adopted by the various Municipalities. The following suggestions might possibly form a basis of future standard regulations:—

(1) The stated contents of the vessel should be such that water cannot boil over.

(2) The normal pressure for which the vessel is built must be stated in a prominent position.

(3) The rated power of the vessel must be clearly indicated. A margin of 10 per cent. shall be allowable for vessels absorbing more than 150 watts, 20 per cent. for vessels absorbing less than 150 watts.

(4) The P.D. for heating elements should be limited to 250 volts. Where the pressure exceeds this value, the neutral wire must be brought to the heater; for instance, for any 2 x 250 or the 220/380 volt three-phrase systems.

(5) No plugs should be allowed for currents which exceed 20 amperes. When this current is exceeded, junctions must be made by means of screwed or soldered joints.

(6) For currents up to 10 amperes plugs may be used for making and breaking the circuit for regulation purposes. The wattage for each part of the circuit must then be clearly stated and in the correct position.

(7) When switches are used for regulation purposes they must be fixed in suitable positions and the switch values must be prominently indicated, either in words or figures. Up to one ampere, the regulator may be placed into the flexible if the latter is permanently fixed to the heater.

(8) When a heater nominally absorbs less than 2,000 watts and is joined to one side of a three-wire or three-phase network, but on switching in absorbs more than 2,000 watts, a starter must be employed.

---

* Abstract of paper read before the S.A. Inst. of Electrical Engineers.

(9) Apparatus joined to pressures exceeding 250 volts must be efficiently earthed.

(10) All flexibles must have soldered ends, and the connections to terminals must be guarded against tensile forces on pulling the flexible.

(11) All connectors, pins, etc., to which the heating wires are connected must be so arranged that they are not interfered with when a new heating element is to be inserted.

(12) Internal connections must be so fixed that when the apparatus is hot the connections are neither loosened nor come in contact with metal parts of the utensil.

(13) The heating wires should be supplied with stout copper connectors before being brought out to the terminals.

(14) All conducting parts must be efficiently insulated from the non-conducting metallic parts.

(15) Creeping gaps must not be less than four millimetres.

TESTING.

(16) The apparatus must be capable of withstanding a test P.D. between heating elements and casing equal to at least 750 volts for utensils working with 250 volts or less, and a P.D. of at least 2½ times the working pressure if the normal working pressure is higher than 300 volts, for at least five minutes, at the normal frequency. The test power available must be at least 1 kilowatt.

(17) All vessels used for heating liquids must be heated with 1.4 times the normal current four times in succession, with the vessel containing the rated quantity of water, from 20 degrees C. to the boiling point, allowing for cooling down to 20 degrees after each operation.

All other apparatus must be fed with 1.4 times the normal current for a period of one half-hour.

Ater carrying out these tests the apparatus must be capable of withstanding the test pressure stated under paragraph 16.

(18) All apparatus must bear the name or sign of the manufacturer.

(19) For three-phase connections, the type, whether star or mesh, must be given.

In order to be able to carry out reliable comparative tests for hot plates or similar utensils, the German Institution of Electrical Engineers accepted the following regulations:—

As the boiling point of water depends upon the barometric pressure, the maximum working temperature is placed at 96 degrees, the original temperature at 20 degrees C.

The vessel is placed with its stated quantity of water at 20 degrees C. exactly upon the scales, is then fed with the correct P.D. and the energy is measured until the temperature of 96 degrees has been reached, determining at the same time the quantity of water which has disappeared as vapour. Care must be taken that all the apparatus employed for the test possesses exactly a temperature of 20 degrees, including the surrounding air.

After this preheating test the water is boiled for 20 minutes, the quantity of water evaporated during this time being accurately measured. The following example will illustrate the test.

Take 1 kilogramme of water at 20 degrees, which absorbs 115 watthours to obtain a temperature of 96 degrees, the loss by evaporation being 3 grammes. We then have:—

To evaporate 3 grammes of water requires 0.003 × 539 1.6 kilogramme-calories = 1.86 watthours. 1,000 — 3 = 997 grammes of water heated from 20 to 96 degrees absorb 0.997 × (96 — 20) = 75.7 kgc. = 88 watthours; hence the efficiency is 78.2 per cent. After bringing the water to the boiling point and boiling on for 20 minutes, 275 grammes of water are evaporated, (for which 0.275 × 539 = 148 kgc. = 172 watthours are required. The consumption during this time was 190 watthours. The efficiency of the apparatus during this boiling period was therefore 90.5 per cent.

Standard vessels should be used in connection with hot plates. The above Society stipulates that vessels must have the same diameter as the hot plate, their weights must be known, their radiation losses determined, the height of the vessel must be 120 millimetres, allowing 30 millimetres for boiling-up space, while the thickness of the bottom of the vessel is given as 10 millimetres, carefully ground, the sides and lid being 1 millimetre thick. The vessels are to be made of polished brass, nickel-plated. The vessel shall have no handles and spout.

I feel sure that regulations on somewhat similar lines would do much to popularise the use of electric cooking appliances. There is little doubt that tne loadings of many elements in hot plates, kettles, ovens, etc., are too high. Once nickel-chrome wire has reached a temperature near the melting point, whether this has occurred throughout its length or only in a few places, the element is finished. The wire has become so brittle that the least mechanical vibration will shatter it. This seems to be little realised. The working temperature of the heating wire should certainly not exceed 600 degrees C. by much. Experiments dealing with the mechanical strength of nickel-chrome wire as function of the working temperature are being carried out at present.

10. COOKING VESSELS FOR LARGE KITCHENS.

A few remarks must suffice here. The large kitchen for several hundreds of people is not obtained by simply increasing the size of the cooking vessels. Utensils for large quantities must be designed on special lines. It is also doubtful whether the large electric ranges, copies of coal ovens, are the right thing. Their current consumption is mostly excessive. Special utensils for each individual dish will yield better results. For meats, potatoes, some vegtables and soups large lagged vessels with sectional heating elements easily detachable, mostly arranged against the bottom of the vessel, but sometimes also round the sides, are then preferable. The vessel itself is usually pivoted between two journals and can be rotated by means of a hand wheel. For puddings, porridge and cabbages, vessels surrounded by oil jackets, the oil being heated by elements in the bottom of the vessel, yield good results. The oil stores heat and completes the cooking after the current has been switched off. The hot oil also keeps the goods warm for a long time. Frying-pans are mostly of wrought iron, with elements in the bottom. In addition, there must be warmers for joints in the servery, warming cupboards, coffee machines and the like. It goes without saying that in the case of large kitchens much greater attention must be paid to the regulations of the current. Per person per principal meal we may reckon roughly about 300 watt-hours. Large kitchens include also knife-cleaning machines, potato-peeling appliances, etc. In fact, most manual work can be done by machinery nowadays. Vacuum cleaners, floor polishers, washing machines, even plate washers, have been in use for years. The large up-to-date factory, the modern ship, etc., do most work electrically, and they do it economically as well.

(To be continued.)

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 186.

When viewing a cinematograph picture, the wheels of a carriage appeared to be turning backwards. Can any reader explain this to me?—"INQUISITIVE."

QUESTION NO. 187.

I wish to use a 100 volt., 3 amp. D.C. motor on 210 volts. Can any reader tell me how to construct a resistance to enable this to be done, since I am told that this is the most economical way of doing it?—"H. W. MAY."

(Replies to Questions Nos. 186 and 187 must be received not later than August 30, 1924.)

Answers to Questions.

QUESTION NO. 181.

The second prize (5s.) has been awarded to "M.M." for the following reply:

It would be simpler as well as cheaper to build up the condenser with paraffined paper than with mica, but as mica is requested, we will take that material as the insulating medium.

The general mathematical formula for the design of electrical condensers, as given by most authorities, is

$$K = \frac{K a}{4 \pi d \, 900{,}000}.$$

where K = capacity in microfarads,
k = the specific inductive capacity of the insulating medium employed,
a = area of tinfoil,
d = thickness of insulating medium

(900,000 is factor to bring the electrostatic units to microfarads).

Suppose now we want a fixed condenser of .003 mf. Take d, thickness of mica, as = .008 cm.; k, for mica, will be about 5. We then find the area of the requisite tinfoil from:

$$a = \frac{K \, 4 \pi d \, 900{,}000}{k}$$

$$= \frac{.003 \times 4 \times \frac{22}{7} \times .008 \times 900{,}000}{5}$$

$$= 54.3 \text{ sq. centimetres.}$$

This area may be in one or any convenient number of sheets.

If we take the sheets of tinfoil 3 cm. × 2 cm., we shall require nine. The mica will have to be about 7 cm. × 6 cm.; this will give a lap of 2 cm. all round over the foil.

Note that the tinfoil must be cut about 6 cm. × 2 cm. to allow for the connections.

In building up, first place a thick mica to form a support. Next a piece of tinfoil which will overlap the mica at one end by 1 cm. Then a piece of thin mica, and immediately over the first mica. The second foil is now placed so that it overlaps at opposite end to the first; now mica and so on. . . . The overlapping foil ends form the terminals of the condenser.

The building up should be done on a hot plate with clean melted paraffin wax. Mica must be perfectly flat and smooth and without any mechanical defects such as perforation, abrasion or corrugation.

The whole should be clamped under pressure until cold and wrapped up tightly, the thick mica end piece will form supports. Condenser will then be ready for use.

Where condensers are to be of guaranteed capacity extra sheets of foil are added which may be removed, if necessary, when the condensers are being tested.

The condenser may be subdivided by suitably connecting the tinfoil sheets; thus two, or more, values may be obtained from one condenser. The metallic sheets of foil act as a number of Leyden jars joined up in parallel; thus the area of tinfoil required for the capacity is divided up in suitable dimensions.

Other sizes of condensers may be calculated in a similar manner.

It goes without saying that every care must be taken when assembling, as it does not take much to damage the dielectric and thus "short" the condenser.—M.M.

Tenders Accepted.—The St. Pancras Borough Council have accepted the tender of the Edison Swan Electric Co., Ltd., for switchboards for sub-stations.

Quotations Wanted.—The Taranaki Electric Power Board, New Zealand, are calling for tenders for transformers.——The Municipality of Stellenbosch are calling for tenders for the supply, erection and installation of complete plant and materials for the generation of electrical power and for lighting the town of Stellenbosch, Cape Province.——Tenders are invited for electrically-driven pumping plants for Christchurch, N.Z.——The Public Works Department, Wellington, N.Z., are calling for tenders for the supply of 6,600 volt oil switches for the Lake Coleridge Power Scheme. Also for the supply of switchgear for the same plant.——The Wairere Electric Power Board, New Zealand, is calling for tenders for the supply of a small hydro-electric plant. Specifications, etc., at the D.O.T. (Room 52), 35, Old Queen Street, London, S.W.1.

NEW CABLE FITTINGS.

The annexed illustrations represent (1) a patented fitting for armoured cable, with a piece of cable therein, and (2) a "tee" junction-box for armoured cables, both of which are manufactured by Mr. George Ellison, of Perry Barr, Birmingham. In connecting armoured cables to ironclad switchgear it is frequently necessary to alter the cable lay-out during installation, and fittings have to be scrapped, which is a serious expense when the bushes are solid brass. The cable cones used in these clamps have been designed to supply the jointer with an easy and adequate means of suitably connecting, and securing, every type and size of cable, conduit or flexible pipe with the minimum trouble, and to provide excellent means of earthing.

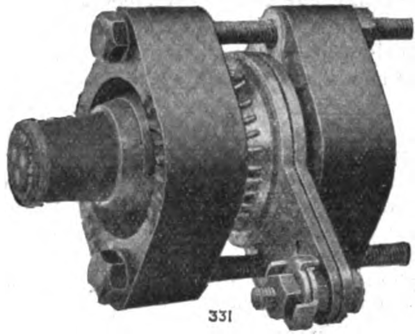


FIG. 1.—ARMOUR CLAMP, SHOWN WITH PIECE OF CABLE.

A complete set consists of three, which may be disposed to meet any emergency.

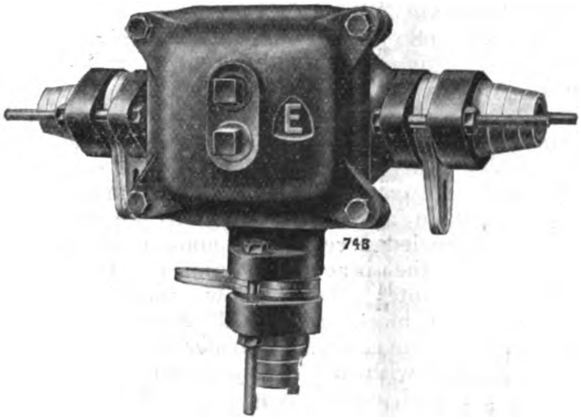


FIG. 2.—"TEE" JUNCTION-BOX FOR ARMOURED CABLES.

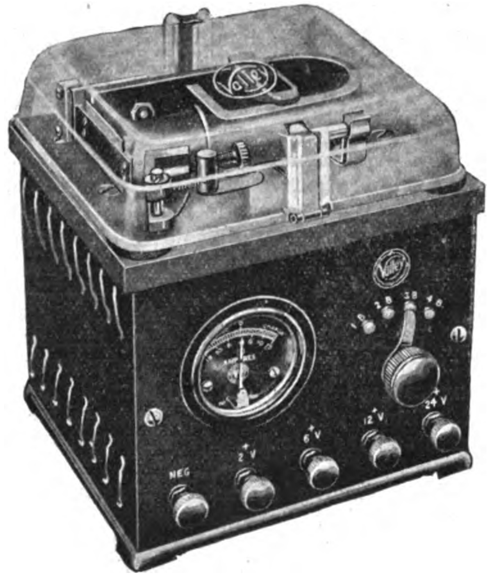
The cones are brass, and have grooves at regular intervals which guide the hack saw, and any required diameter is obtained by cutting at the nearest groove and enlarging with a file, if necessary. This avoids the use of large drills, which are not carried in any jointer's kit.

South Africa.—The July issue of our contemporary, the *South African Power Engineer,* which is published at Johannesburg, contains a detailed illustrated description of the principal features of the new Colenso power station, which is being erected by the S. Africa Railway Administration to supply power for the Maritsburg-Glencoe Electrification Scheme, which represents the last word in modern power plant design and equipment. It is a wonderfully comprehensive article, and indicates the great progress which is being made with railway electrification schemes in the British Colonies.

THE "VALLEY" BATTERY CHARGER.

For listeners possessing valve sets which necessitate the use of accumulators for the filament circuits, the one fly in the ointment is the periodical transporting of the battery to a charging station and its collection after being charged. Those who are fortunate enough to be connected to a D.C. supply for electric lighting are often able to undertake the charging of their batteries at home by using lamps or some other resistance in series. Consumers on alternating current networks, however, are unable to do this without employing some form of rectifying apparatus, of which many designs have appeared on the market.

These rectifiers are of several types, and include small motor-generators and rotary converters, electrolytic rectifiers, others employing vacuum tubes or valves, the well-known mercury arc rectifier, and lastly the vibrating reed electromagnetic type. The last-mentioned, by reason of its simplicity of design and operation, is by far the most popular among amateurs, and can be thoroughly recommended as a satisfactory and efficient type of apparatus, inexpensive in first cost and not likely to involve undue expenditure in renewals and maintenance. A good example of this form of charger is the "Valley" battery charger, described in leaflet No. V.3309 issued by the General Electric Co., Ltd., and shown in our illustration. It consists essentially of two portions, (*a*) a transformer, the secondary of which is tapped to supply circuits at 2, 6, 12 and 24 volts respectively; and (*b*) the rectifying element. This comprises a compound magnetic circuit composed of a permanent magnet and a small electromagnet energised by the A.C. supply, and a vibrating armature carrying a silver plate which makes contact during alternate half-cycles with a heavy carbon contact.



The moving portion of the apparatus is mounted on a slate base on the top of the case containing the transformer, and, together with a replaceable fuse in the battery circuit, is protected by a moulded glass cover.

The front of the instrument is a panel of Bakelite carrying a flush type ammeter which indicates the value of the charging current, clearly marked terminals machines and the like. It goes without saying that in the case of large kitchens much greater attention must be paid to the regulations of the current. Per person per principal meal we may reckon roughly about 300 watt-hours. Large kitchens include also knife-cleaning machines, potato-peeling appliances, etc. In fact, most manual work can be done by machinery nowadays. Vacuum cleaners, floor polishers, washing machines, even plate washers, have been in use for years. The large up-to-date factory, the modern ship, etc., do most work electrically, and they do it economically as well.

(To be continued.)

Questions and Answers by Practical Men.

RULES.

Questions: We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.

Answers: A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

Question No. 186.

When viewing a cinematograph picture, the wheels of a carriage appeared to be turning backwards. Can any reader explain this to me?—"Inquisitive."

Question No. 187.

I wish to use a 100 volt., 3 amp. D.C. motor on 210 volts. Can any reader tell me how to construct a resistance to enable this to be done, since I am told that this is the most economical way of doing it?—"H. W. May."

(*Replies to Questions Nos.* 186 *and* 187 *must be received not later than August* 30, 1924.)

Answers to Questions.

Question No. 181.

The second prize (5s.) has been awarded to "M.M." for the following reply:

It would be simpler as well as cheaper to build up the condenser with paraffined paper than with mica, but as mica is requested, we will take that material as the insulating medium.

The general mathematical formula for the design of electrical condensers, as given by most authorities, is

$$K = \frac{K a}{4 \pi d \, 900{,}000.}$$

where K = capacity in microfarads,
k = the specific inductive capacity of the insulating medium employed,
a = area of tinfoil,
d = thickness of insulating medium

(900,000 is factor to bring the electrostatic units to microfarads).

Suppose now we want a fixed condenser of .003 mf. Take d, thickness of mica, as = .008 cm.; k, for mica, will be about 5. We then find the area of the requisite tinfoil from:

$$a = \frac{K \, 4 \pi d \, 900{,}000}{k}$$

$$= \frac{.003 \times 4 \times \frac{22}{7} \times .008 \times 900{,}000}{5}$$

= 54.3 sq. centimetres.

This area may be in one or any convenient number of sheets.

If we take the sheets of tinfoil 3 cm. × 2 cm., we shall require nine. The mica will have to be about 7 cm. × 6 cm.; this will give a lap of 2 cm. all round over the foil.

Note that the tinfoil must be cut about 6 cm. × 2 cm. to allow for the connections.

In building up, first place a thick mica to form a support. Next a piece of tinfoil which will overlap the mica at one end by 1 cm. Then a piece of thin mica, and immediately over the first mica. The second foil is now placed so that it overlaps at opposite end to the first; now mica and so on. . . . The overlapping foil ends form the terminals of the condenser.

The building up should be done on a hot plate with clean melted paraffin wax. Mica must be perfectly flat and smooth and without any mechanical defects such as perforation, abrasion or corrugation.

The whole should be clamped under pressure until cold and wrapped up tightly, the thick mica end pieces will form supports. Condenser will then be ready for use.

Where condensers are to be of guaranteed capacity extra sheets of foil are added which may be removed, if necessary, when the condensers are being tested.

The condenser may be subdivided by suitably connecting the tinfoil sheets; thus two, or more, values may be obtained from one condenser. The metallic sheets of foil act as a number of Leyden jars joined up in parallel; thus the area of tinfoil required for the capacity is divided up in suitable dimensions.

Other sizes of condensers may be calculated in a similar manner.

It goes without saying that every care must be taken when assembling, as it does not take much to damage the dielectric and thus "short" the condenser.—M.M.

Tenders Accepted.—The St. Pancras Borough Council have accepted the tender of the Edison Swan Electric Co., Ltd., for switchboards for sub-stations.

Quotations Wanted.—The Taranaki Electric Power Board, New Zealand, are calling for tenders for transformers.——The Municipality of Stellenbosch are calling for tenders for the supply, erection and installation of complete plant and materials for the generation of electrical power and for lighting the town of Stellenbosch, Cape Province.——Tenders are invited for electrically-driven pumping plants for Christchurch, N.Z.——The Public Works Department, Wellington, N.Z., are calling for tenders for the supply of 6,600 volt oil switches for the Lake Coleridge Power Scheme. Also for the supply of switchgear for the same plant.——The Wairere Electric Power Board, New Zealand, is calling for tenders for the supply of a small hydro-electric plant. Specifications, etc., at the D.O.T. (Room 52), 35, Old Queen Street, London, S.W.1.

NEW CABLE FITTINGS.

The annexed illustrations represent (1) a patented fitting for armoured cable, with a piece of cable therein, and (2) a "tee" junction-box for armoured cables, both of which are manufactured by Mr. George Ellison, of Perry Barr, Birmingham. In connecting armoured cables to ironclad switchgear it is frequently necessary to alter the cable lay-out during installation, and fittings have to be scrapped, which is a serious expense when the bushes are solid brass. The cable cones used in these clamps have been designed to supply the jointer with an easy and adequate means of suitably connecting, and securing, every type and size of cable, conduit or flexible pipe with the minimum trouble, and to provide excellent means of earthing.

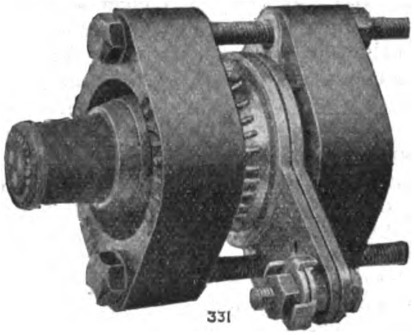


FIG. 1.—ARMOUR CLAMP, SHOWN WITH PIECE OF CABLE.

A complete set consists of three, which may be disposed to meet any emergency.

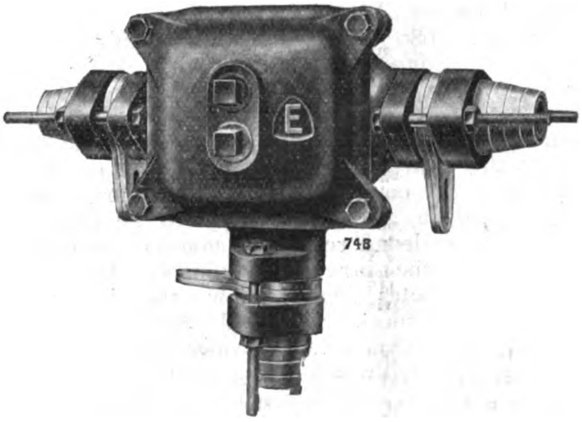


FIG. 2.—"TEE" JUNCTION-BOX FOR ARMOURED CABLES.

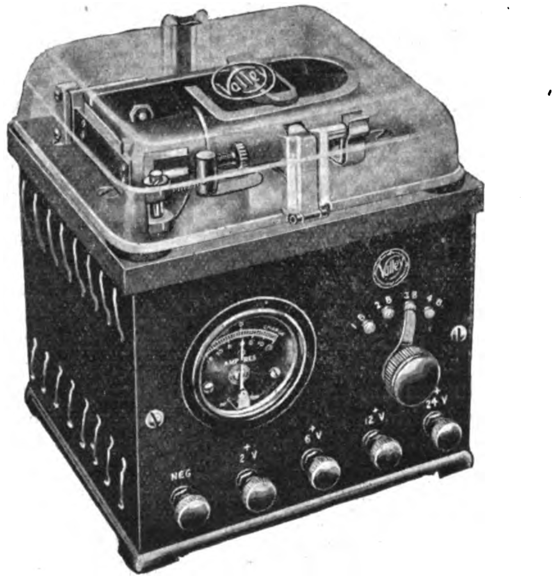
The cones are brass, and have grooves at regular intervals which guide the hack saw, and any required diameter is obtained by cutting at the nearest groove and enlarging with a file, if necessary. This avoids the use of large drills, which are not carried in any jointer's kit.

South Africa.—The July issue of our contemporary, the *South African Power Engineer*, which is published at Johannesburg, contains a detailed illustrated description of the principal features of the new Colenso power station, which is being erected by the S. Africa Railway Administration to supply power for the Maritsburg-Glencoe Electrification Scheme, which represents the last word in modern power plant design and equipment. It is a wonderfully comprehensive article, and indicates the great progress which is being made with railway electrification schemes in the British Colonies.

THE "VALLEY" BATTERY CHARGER.

For listeners possessing valve sets which necessitate the use of accumulators for the filament circuits, the one fly in the ointment is the periodical transporting of the battery to a charging station and its collection after being charged. Those who are fortunate enough to be connected to a D.C. supply for electric lighting are often able to undertake the charging of their batteries at home by using lamps or some other resistance in series. Consumers on alternating current networks, however, are unable to do this without employing some form of rectifying apparatus, of which many designs have appeared on the market.

These rectifiers are of several types, and include small motor-generators and rotary converters, electrolytic rectifiers, others employing vacuum tubes or valves, the well-known mercury arc rectifier, and lastly the vibrating reed electromagnetic type. The last-mentioned, by reason of its simplicity of design and operation, is by far the most popular among amateurs, and can be thoroughly recommended as a satisfactory and efficient type of apparatus, inexpensive in first cost and not likely to involve undue expenditure in renewals and maintenance. A good example of this form of charger is the "Valley" battery charger, described in leaflet No. V.3309 issued by the General Electric Co., Ltd., and shown in our illustration. It consists essentially of two portions, (*a*) a transformer, the secondary of which is tapped to supply circuits at 2, 6, 12 and 24 volts respectively; and (*b*) the rectifying element. This comprises a compound magnetic circuit composed of a permanent magnet and a small electromagnet energised by the A.C. supply, and a vibrating armature carrying a silver plate which makes contact during alternate half-cycles with a heavy carbon contact.



The moving portion of the apparatus is mounted on a slate base on the top of the case containing the transformer, and, together with a replaceable fuse in the battery circuit, is protected by a moulded glass cover.

The front of the instrument is a panel of Bakelite carrying a flush type ammeter which indicates the value of the charging current, clearly marked terminals for connecting 2, 6, 12 or 24-volt batteries, and switch for varying the charging rate of 24-volt H.T. units being charged in parallel.

The "Valley" charger is made in two stock windings, one for operating on 50-cycle circuits at voltages between 100 and 125, and the other for 50-cycle circuits between 200 and 250 volts. Chargers for non-standard periodicities between 25 and 65 cycles can be specially made. The standard apparatus charges 2-volt and 12-volt batteries at approximately 3 amperes, 6-volt batteries at 6 amperes, and 24-volt H.T. batteries at approximately 0.1 to 0.4 amperes.

Operation is simplicity itself, as the instrument is connected to the A.C. supply by an ordinary lampholder or wall-plug, while the accumulator is connected to the appropriate terminals on the front of the machine. The employment of a permanent magnet in the magnetic system fixes the polarity once and for all, and the silver-carbon combination used for the contacts reduces the necessity of adjustment to the minimum.

A NEW AMERICAN ELECTRIC FURNACE.

A new industrial hearth-type electric furnace, known as type B, for operation up to 1,850 degrees Fahrenheit, has been recently perfected by the Westinghouse Electric and Mfg. Co., of Pittsburg. It is made with hearth sizes ranging from 4 in. wide and 10½ in. deep to 12 in. wide and 36 in. deep, and is particularly well suited for such operations as annealing, hardening, tempering, normalising, carbonising, case-hardening, vitreous enamelling, and for laboratory work. Automatic temperature control makes it possible to duplicate heating conditions as often as is necessary and enables a predetermined manufacturing schedule to be carried out.

One of the distinctive features of this new furnace is that the muffle plates, which completely enclose the heating chamber, are perforated so that heat is radiated directly from the heating element to the charge. This unusual construction permits a higher temperature in the heating chamber without undue deterioration of the heating elements. These elements, which consist of S-bend coils of nickel-chromium wire, are placed on all four sides of the heating chamber and are supported and aligned by moulded studs on the muffle plates.

The door of the type B furnace is suspended by a chain from one point, which, being always on the circumference of an arc at the end of the operating handle, maintains a position directly over the centre of the door when it is being opened or closed. This method of operation prevents the door from sticking or jamming in its guides. Pieces of angle iron bolted to the guides are so adjusted that the door is held closely against the front casting when closed, but can move easily when being opened.

A superior point in the design of this new furnace is the arrangement of the insulation so that the muffle plates do not carry any of the weight. Standard insulating bricks next to the shell are supported by the high temperature insulation, which is in the form of slabs. In this way, the muffles are relieved of the weight of the insulation, a desirable feature in this type of furnace.

The furnace shell, or casing, is of heavy sheet steel, with the sides and bottom in one piece. The top, however, is a separate piece, to facilitate removal for the purpose of making repairs to the insulation or heating element.

The rear casting design is a frame supporting an asbestos panel through which the ends of the heating coil protrude. Heavy air-cooled connectors join the coils in series and connect to the lines.

One of the many advantages of the electric furnace is its automatic control, enabling the operator to maintain a desired temperature indefinitely. The automatic electric control consists of a control pyrometer, a relay and magnetic contactor. In the control instrument, a sationary pointer carrying two electric contacts is set at the desired temperature and the furnace turned on by a conveniently located push-button. As the temperature rises, an indicating hand in the control instrument, actuated by a thermo-couple in the furnace chamber, moves along the scale. When it reaches the upper of the two contacts carried by the stationary pointer, the relay is energised, opening the magnetic contactors and cutting off the current. When the temperature falls to the point where the indicating hand reaches the lower of the contacts on the stationary pointer, the relay cuts the current on again. This cycle, continuing as long as the furnace is in operation, maintains the temperature within approximately 1 per cent. of the desired point without any attention on the part of the operator.

Reviews of Books, &c.

[*Books noticed in this column will be sent from* Electricity *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.*]

The Journal of the Institute of Metals: Vol. XXXI. 680 pp.; 40 plates and numerous figures in the text. Edited by G. Shaw Scott, M.Sc. (Institute of Metals, 31s. 6d. net.)—Sir Henry Fowler's lecture on the use of non-ferrous metals in engineering, which appears in full for the first time in the present issue of this *Journal*, is indeed a notable contribution to the literature on the subject. Sir Henry brings to a focus, and in a manner easily to be understood, up-to-date knowledge regarding non-ferrous metals as they concern the practical engineer. The fourteen papers and notes that follow the lecture are, individually, of more specialised interest, but in the aggregate they cover an even wider field. The metals and alloys dealt with include brass, aluminium, copper, bronze, zinc, lead, cadmium and tin. The papers that have induced the fullest discussion are those by Mr. W. E. W. Millington and Prof. F. C. Thompson on the investigation of a fatigue failure of brass tubes in a feed-water heater and by Messrs. E. R. Jette, G. Phragmén and A. F. Westgren—three Swedish investigators—on X-ray studies on the copper-aluminium alloys. In both cases new views are advanced—and they receive a full measure of criticism. The papers and notes—which comprise about one-half of the volume—are preceded by the address of the new president, Prof. T. Turner, of Birmingham University, who deals principally with the initiation and conduct of scientific research, pointing out that good and reliable work can often be accomplished without elaborate apparatus. He calls attention to the importance of the work done by the Institute of Metals since its foundation in 1908, and shows how this work could be extended were the Institute in possession of endowments such as those which enable the older technical institutions continually to increase their activities. The second portion of the book contains over 1,500 concise abstracts, specially prepared from 500 periodicals—of which an easy reference list is given in a novel " key " form—dealing with all aspects of metallurgical work in every part of the world. The bibliography of the subject is dealt with in an equally comprehensive manner, whilst the index to the whole volume is a model of completeness, being very detailed and thoroughly cross-referenced.

Continuous Current Circuits and Machinery. By Morecroft and Hehre. Medium 8vo, cloth, 467 pp., 377 illustrations. (Chapman and Hall; 20s. net.)—This is one of the new text books in which the engineering student and scientist is introduced at the outset to a brief but none the less clear description of the electron theory, and electrostatics generally, the authors holding the opinion, with which we agree, that although not actually essential for the solution of electrical problems, yet a knowledge thereof, even if elementary, will render his work far more interesting. It is a most comprehensive work, dealing clearly with the fundamental principles of all branches of continuous current machinery and plant, including the laws which govern the electric circuit, the various types of meters which are associated with C.C. work, generators, motors, electric welding plant, batteries, both primary and secondary, and a wonderfully explicit chapter on operation and management, concluding with a short list of typical experiments. Each chapter finishes with a series of questions and problems, and as there is an ample supply of first-class and clearly printed diagrams the book is certain to meet with the cordial approval of all who study it. It imparts knowledge easily yet accurately, and that is the great object.

Regulations for the Electrical Equipment of Buildings. 8th Edition. Pett 8vo, 124 pp. (Spon, paper 1s., cloth 1s. 6d.)—We congratulate the Institution on the production of the new edition of the " Regulations, etc., etc.," or, as they are more familiarly termed, the " Wiring Rules," and feel certain that their adoption as standard by approximately 500 of the leading fire offices, municipal authorities and electricity supply companies will be more than sufficient to disarm criticism which might be made by any particular section of the industry. Undoubtedly they represent the agreed views of the majority, at least, of the committee to which the preparation of this contentious problem was entrusted, and thanks are due to Mr. Wordingham (the chairman), Mr. Atkinson (the vice-chairman), and all the members for the days and weeks of valuable private time which must have been spent in licking them into a form which can be presented as a set of regulations which should meet the demands of the present day and yet have a certain amount of flexibility. We expect the edition will have a very rapid sale.

Alternating Current Armature Winding. By Terrell Croft. Large post 8vo, cloth, 352 pp., 326 diagrams. (McGraw Hill, 15s. net.)—Books on armature winding are none too plentiful, and Mr. Croft's book is certain to receive a cordial welcome from all practical men who are interested in the winding or repair of alternating current stators. The diagrams are both excellent and comprehensive, covering, as they do, the standard connections of one, two and three phase armatures, and in company with the very lucid text afford clear instructions how to assemble and connect a new winding into the stator, how to avoid errors in connection, and also the feasibility or otherwise of rewinding for operation at voltage, frequency phase or speed other than that for which the machine was originally designed. The book is essentially practical, and wherever possible the principles involved are explained with worked-out figures, based on a working knowledge of elementary arithmetic. One division is devoted to a description of errors which are likely to be made in connecting an armature winding, and how to locate them if they exist. In addition, there are questions and problems at the ends of certain chapters which should prove of direct educational value, and altogether the book is likely to find a very wide sphere of usefulness. It contains a wealth of information for all armature winders.

Business Builders or Business First Principles. By A. F. Shepherd. (Business Builders, Ltd., cloth, 1s. net.)—This little book deals in a very readable style with the all-important subject of publicity as affecting all men of affairs and all classes of business. Its issue at such an opportune time, after the great Advertising Convention, assures it a hearty reception by all interested in advertising and its objects. It lays down some excellent maxims and presents the subject in an entirely new light to the average reader.

THE FIRST WIRELESS.

In the Pageant of Empire at Wembley, the sending of the first transatlantic wireless message is featured.

How the Atlantic was bridged by wireless is in itself a world romance. In the Newfoundland pageant the story of how the letter " S " was sent from Poldhu, Cornwall, and received on three successive days by Cav. Marconi and his two English assistants—Mr. Kemp and Mr. Paget—is repeated.

It was a cold December, and the weather was an alternation of snowstorms, wind and rain. Kites and balloons which were used to carry the aerial were repeatedly blown away, and the operators' hands were torn in trying to hold the wires. The atmospherics were bad, but the indomitable pluck of the inventor and his friends was rewarded. In Senator Marconi's own words, the episode is related as follows:—

" I sent up kites every day that week with the vertical aerial wire appended by which our signals were received. I had previously cabled to my station at Cornwall to begin sending the pre-arranged signal. On Wednesday my kite broke away and nothing resulted. Thursday, however, I had better luck. My arrangement was for Cornwall to send at specific intervals between 3 and 6 p.m. the Morse letter ' S ' (. . .). The hours named were equivalent to from noon to 3 p.m. at St. John's, and Thursday, during these hours myself and my assistant, Mr. Kemp, received these signals under such conditions as assured us they were genuine. We received them through a specially sensitive telephone attached to our instrument, which enables us to detect the most delicate signals. The combinations were perfect and strong; the test was conclusive, though not practically effective.

On Friday we tried again, and were rewarded with audible signals, though fainter than on Thursday. This I attributed to the trouble we had in keeping our kite elevated, owing to baffling winds. But this test made further doubt impossible. After Thursday's success I wired my principals in London, for we could only receive."

Thus the great inventor described the reception of the first wireless signals across the Atlantic. Mr. Kemp, who was with Marconi on this famous occasion, and has been with him ever since, will be in the little hut which has been constructed in the Stadium in facsimile of the famous wood hut on Signal Hill. Wireless is to-day a part of our daily life, and the exultation which the inventor and his two assistants felt on that Thursday morning is fully justified in knowing that his invention is to-day almost a *sine qua non* of human existence.

Trade Notes.

Leaflet R7380B has just been issued by the **B.T.-H. Co.** It describes their latest types of head telephones and accessories with prices, and should, therefore, be of interest to all dealers in wireless supplies.

The **Arora Co.**, Loughborough, have issued a list descriptive of a new type of electric fire in sheet metal, which they call the "Wembley." Two of the new features therein are the standard wirings, which are mounted on a fire-clay backing with a bowed front, and an entirely new finish in bright, rustless steel. The trade in electric heating and cooking apparatus is certain to advance rapidly in the near future, and contractors and factors should make a point of obtaining copies of the new list without delay.

Leaflet 1034, which has just been issued by **Simplex Conduits, Ltd.**, introduces, on pages 2 and 3, some new ranges of conduit fittings at highly competitive prices. These are not intended to replace the company's standard patterns, but to meet the pronounced demand in many markets for competitive material. On page 4 there are printed details of the Junior pattern of the famous "Diaduct" series of distribution boards. The list, therefore, should be of direct interest to all installation contractors and engineers in charge of plant, to whom it will be sent willingly on application.

A card circular describing a special offer which is being made by the **Automatic Electric Furnaces, Ltd.**, of 173, Farringdon Road, London, E.C.1, should appeal to all who are interested in the subject of high quality steel tools.

We have received from the **General Electric Co., Ltd.**, a copy of the newly-issued 21st edition of their Catalogue Section L (1) dealing with electric bells and bell material. As might be expected, it is extremely comprehensive and contains full details, illustrations and prices of every accessory necessary for the installation of bell systems, burglar alarms, and lightning conductors, etc. The contents of this catalogue have been thoroughly revised to include not only all standard apparatus, but also several new and competitive lines. In nearly every instance very substantial reductions in price have been made, but this has been achieved without in any way sacrificing either quality or workmanship, the high standard of which has been fully maintained. Distribution of this list to the trade is now being made, and we recommend all electrical contractors, dealers and ironmongers, and these responsible for carrying out bell installations, to obtain a copy without delay.

A new leaflet from **Automatic and Electric Furnaces, Ltd.**, of 173-175, Farringdon Road, London, E.C.1, deals with oven furnaces, *i.e.*, furnaces with the heaters inside the chamber, exposed but yet protected. It has been designed to give uniformity of temperature throughout the mass of material heated, and the automatic temperature control secures that the temperature attained shall always be the same. The time switch secures that the heating time shall also always be repeated, a matter which is often of the utmost importance. The cost of running is small, tests having shown that gas and electricity are on a par when gas costs 2s. 10d. per thousand and electricity costs 1d. per unit, besides which electricity has a great advantage over gas in uniformity of temperature throughout the mass and in the absence of fumes, which for many classes of work are deleterious.

Various Items.

Lithuania.—A report on the industrial conditions in this country has just been issued, and shows that Germany provides the greater part of the electrical goods which are imported, due to the fact that British prices are said to be too high.

Wireless Apparatus in Norway.—A report on the market for wireless apparatus in Norway has been prepared by the D.O.T., and U.K. firms desirous of receiving a copy should communicate with the Department of Overseas Trade, 35, Old Queen St., London, S.W.1.

Carnival.—It is proposed to hold an electrical carnival and dance at Wembley about the third week in September, and we are certain that should such be the case it will receive enthusiastic support from the exhibitors in the electrical section. Further details next week.

New Mullard Valves.—Wireless traders and dealers will be interested in the advertisements of new Mullard Valves in this issue, and should make a point of writing the company at once and asking for technical leaflet V.R. 18, which gives much valuable information thereon.

Finance.—The directors of W. T. Henley's Telegraph Works Co., Ltd., have declared a dividend on the preference shares at the rate of 4½ per cent. per annum, less income tax, for the half-year ended June 30 last. Also an interim dividend on the ordinary shares of 1s. per share, less income tax.

The Machine Tool Exhibition.—We notice in the preliminary list of exhibitors the names of 122 well-known firms who have taken space, and there is no doubt that from September 5 to 27 Olympia will be visited by a large number of engineers who are interested in machine tools and engineering generally.

Power from Ocean Heat.—We have received from Mr. H. G. Harley, of Grand Avenue, Camberley, Surrey, a pamphlet descriptive of his scheme for the generation of power by the means of utilising the difference in the temperature of the ocean at higher and lower levels. The idea should appeal to all readers who are interested in the production of power by utilising the available forces of nature.

New Address.—Owing to the growth of their business and the urgent need for a more central office, the G.W.I., Ltd., have removed to "Imperial House," 43, Grafton Street, Tottenham Court Road, London, W.1, where they intend to fit up a small showroom for demonstrating battery charging apparatus and other specialities, and will keep a stock of their new plateless valves for the convenience of the London district clients.

Electro Farming.—The paper on this subject which was read by Mr. Borlase Matthews before the South Wales Institute of Engineers at Cardiff on Friday, November 24, 1922, has been reprinted in pamphlet form by the South Wales Electrical Power Co., Ltd., of Cardiff, and is being distributed widely by that very enterprising company, in order to do its utmost to promote the use of electricity in agriculture in the district which is covered by its undertaking. This should, have a useful effect in many other directions, and with this end in view they will be very pleased indeed to send copies to any readers who are interested in this particular subject.

Calculators.—The time is now coming when a very large number of engineers and readers of this paper will have finished their holidays and returned to work with renewed energy. We feel certain that many of them will be interested in the Otis King Calculator, of which an advert. appears in our pages, and we would suggest that they write at once to Carbic, Ltd., and ask for a copy of the illustrated folder E.L., which gives full details of the work which can be carried out with this very useful calculating apparatus. It has proved its value in many directions, and we are not surprised to hear that it is meeting with a very ready sale in all parts of the world.

A New "Xcel" Connector.—We have received from Automatic Telephone Manufacturing Co., Ltd., makers of the well-known "Xcel" Domestic Electric Appliances, a sample of a new metal-sheathed connector they have just introduced as an improvement upon the existing model, which is of moulded insulating material. The new type, H. 739 Connector, has a pressed brass nickel-plated case with tough porcelain interior, and embodies the great advantage and special feature of a side entrance for the flexible. The new connector is immensely strong and will resist fracture even if the appliance to which it is attached be accidentally dropped. The side entrance for the flexible keeps the latter away from the user's arm and indefinitely prolongs the life of the flex at this very vital spot.

Facing responsibility is the best way to get backing.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

AUGUST 22, 1924

CONTENTS.

	PAGE
Important to All Readers	435
Long-Distance Reception with a Crystal Detector	435
Pulverised Fuel	435
An Interesting Exhibit	436
The " Railodoks " and Launches at Wembley	436
Marconi 500-Watt Pack Stations	438
Current Topics	441
An International Radio Week	443
Telegraphy	443
The Electrical Kitchen for Private Houses	444
Questions and Answers by Practical Men	445
Reviews of Books	445
Various Items	446

IMPORTANT TO ALL READERS.

September 5 is an important date in the annals of this journal, since upon that day ELECTRICITY will reappear in its original coloured cover of apple green. Readers will remember that, owing to the difficulty of obtaining coloured paper during the war, we were reluctantly compelled to adopt a white cover. We never did like the white cover, and, from letters received from different parts of the world at various times, we are aware that our readers shared our dislike. There is something, after all, in the cover of a journal which appeals to its readers. It is something distinctive which makes it stand out from among others as *the* journal. So, dear readers, look out in future for the apple green one in your newsagents' shops and upon railway station bookstalls.

In this issue of ELECTRICITY we are commencing what we hope will be a popular feature with our readers, and which will enhance our reputation as a POPULAR TRADE JOURNAL. The feature is, briefly, as follows :—

We are going to devote a certain amount of space each week to " PRACTICAL ELECTRICAL ENGINEERING HINTS." We feel sure that in the whole of the branches of the electrical engineering industry there are various ways of doing certain things, some of them being better than others. At times an armature winder has to make a new tool, or an electrical fitter has to do a job in a special way, etc. It is these hints we are after, and we invite all readers to send them along, with illustrations. All published matter will be paid for at our usual rates. In this way readers will not only be benefiting themselves in a financial way, but they will be assisting their fellow-workers by giving them the benefit of their experience.

LONG-DISTANCE RECEPTION WITH A CRYSTAL DETECTOR.

The Marconi Co. have received a report from one of their sea-going staff that when the ship was at Algiers the 2LO concerts were received clearly and with good strength on a standard Type 31 ship receiver, which uses a carborundum crystal. The distance between the two points is approximately 966 miles. This reception is extraordinarily good when one considers that the output from the Marconi House transmitter is less than 1½ kw., and in addition that the waves have to pass, to a large extent, over land, and are, therefore, subject to attenuation, more so than if they traversed an all-sea route.

Another report of crystal reception, but this time of the high-powered station at the Marconi works at Chelmsford, was received from Denmark. Here again the receiver was the standard Type 31 crystal, and the Chelmsford broadcasting was clearly received at a distance of roughly 550 statute miles in daylight.

The Marconi crystal receiver supplied to ships is a coupled circuit receiver, which has a wave range of 300 to 2,800 metres. An inductance, a part of which is variable, is placed in series in the aerial circuit, and a part of this inductance is inductively coupled to a secondary coil which is tuned by means of a condenser in parallel. The carborundum crystal is in series with a pair of telephones across the secondary circuit. It is necessary, of course, with a carborundum crystal to apply a potential by means of a potentiometer, and an extremely sensitive adjustment can be obtained in consequence, making the apparatus a very efficient receiver under varying conditions such as arise more on shipboard than in any other place.

PULVERISED FUEL.

It is well known that the real pioneer of pulverised fuel firing for large water tube boilers is Mr. John Anderson, of Milwaukee, and a short time ago the Underfeed Stoker Co., Ltd., gave a private dinner at the Connaught Rooms, London, to about 150 prominent engineers, to meet Mr. Anderson, over here in connection with the World Power Conference, the guests including Mr. Frank Hodges (Civil Lord of the Admiralty).

After the dinner Mr. Anderson gave a detailed account, illustrated with a very large number of lantern slides, of the whole history of the Lakeside power station of the Milwaukee Electric Railway and Light Co., which was the first power plant in the world exclusively fitted with " Lopulco " pulverised fuel firing, following upon several years' detailed investigations at the smaller Oneida St. plant, Milwaukee, of the same company. Mr. Anderson, who hails from Aberdeen, stated that he was originally a marine engineer on the old Inman Line (now the American Line). and he first saw a boiler firing pulverised coal at Coney Isle, New York, in 1900. He commenced serious experiments with this principle at the Oneida St. plant of the Milwaukee Electric Light and Power Co., of which, of course, he is the chief engineer, in 1918, and after three years' work it was decided to equip the huge new Lakeside station at Milwaukee with nothing but pulverised fuel. Up to the present time over 1,250,000 tons of pulverised coal has already been burnt at

Lakeside, the first 40,000 kw. of which started up in December, 1920. This station to-day still contains the most efficient boiler plant in the world, running continuously at 85-86 per cent. efficiency, and a second installation of 60,000 kw. has now started up, whilst a further 30,000 kw. will be in operation by next Christmas.

Much further interesting information was given which space does not permit us to print, but with regard to ash troubles, which would be an important point in this country, Mr. Anderson stated that it was quite easy to catch nearly all of it before leaving the chimney shaft if it was thought necessary, either by a washing plant or electrical precipitations method, and that the new Trenton Channel station of the Detroit Edison Co., also fitted with "Lopulco" pulverised fuel, is being equipped with electrostatic dust separating apparatus having 99 per cent. efficiency guarantee.

AN INTERESTING EXHIBIT.

On page 186 of our April 11 issue we gave an illustrated description of the G.E.C. "Wembley" lantern, in the course of which we referred to the stringent tests made to prove that it was to all intents and purposes practically "weatherproof." An actual demonstration of this fact may now be seen at the G.E.C. Pavilion, in the Palace of Engineering, where one of the lanterns is enclosed in a glass tank under the continual bombardment of a number of water jets which strike the lantern body, conductors, and even the live terminals, with considerable force, thus proving its suitability to withstand the severest weather conditions, and at the same time provide such ventilation that the normal life of a 1,500-watt "Osram" lamp is unimpaired.

THE "RAILODOKS" AND LAUNCHES AT WEMBLEY.

A short time back the members of the technical Press were afforded an opportunity of inspecting at Wembley the garage and plant of the little "Railodok" vehicles which have proved such an attraction at the British Empire Exhibition, and have indeed added much to the comfort of many thousands of visitors to that great show.

As industrial electric trucks "Railodoks" are firmly established as a means of economy in material handling in factory, dock, warehouse and yard; but the Wembley fleet provides the first example of the use of electric trucks on a large scale for passenger carrying. The design of the "Railodok" was originally based upon years of experience of industrial conditions. Primarily intended, therefore, to operate upon smooth roads and concrete or wooden floors, the trucks must be credited with an achievement of some merit, shared by the "Kathanode" batteries with which they are equipped, in that they have successfully negotiated, at the slow speed dictated by considerations of public safety, the irregular and often muddy Exhibition roads, containing several stiff gradients.

Each Wembley vehicle consists of a "Railodok" truck as chassis (Fig. 1), fitted with "garden seat" type accommodation for 12 passengers, and equipped with a canopy which affords head cover to both passengers and driver. A folding step runs the complete length of the vehicle to assist passengers to board and alight. This step is operated by a lever on the driver's platform, and when in the "lifted" position lies flat along the side of the chassis, thus keeping the overall width of the vehicle down to the minimum.

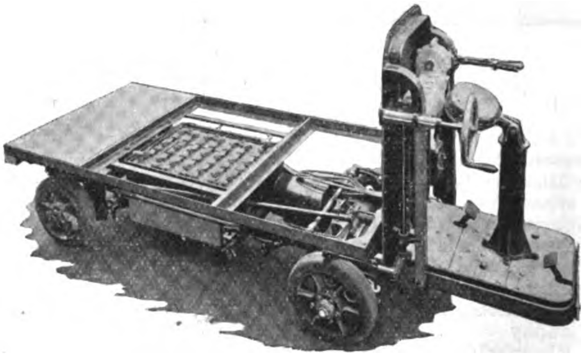


FIG. 1.—STANDARD "RAILODOK" INDUSTRIAL TRUCK WITH SECTIONS OF PLATFORM REMOVED, SHOWING THE MOTOR AND STORAGE BATTERY.

The passenger seats, which are placed transversely so that the passengers have an uninterrupted view to both left and right, are easily removable to give access to the motor and to the "Kathanode" battery; while that occupied by the driver is hinged and sprung, and so mechanically and electrically interlocked with the brake and controller that immediately his weight is removed the brake is automatically applied and the current cut off. This is a very efficient safety device, which is doubly desirable when the trucks are used for the conveyance of passengers—particularly in congested localities such as exhibitions, parks, fêtes, seaside promenades and piers.

All the trucks composing the Wembley "Railodok" fleet are equipped with lead accumulators of the "Kathanode" type, manufactured at Bakewell, Derbyshire, by the D.P. Battery Co., Ltd., whose stand is in Avenue 13, Bay 5, of the Palace of Engineering.

The batteries consist of 21 cells, each containing 19 plates. The construction of "Kathanode" cells is in several ways unique, and involves principles which render the cells unusually robust without detracting in any way from their efficiency. In effect, this design marks an entire departure from previous methods, one of the principal features being an indestructable envelope acting as separator, which holds the active material firmly in place, and at the same permits the chemical action of the cell to proceed normally. The manufacturers claim many other advantages for their batteries, and these are set out in their own descriptive leaflet—a publication of interest to all users of traction batteries.

In spite of the very exacting conditions which prevail at Wembley—where some of the gradients are as steep as 1 in 10—it has been found possible to obtain a run of approximately 18 miles on a single charge—a distance which can naturally be materially increased under more favourable conditions, such as those which normally obtain in purely industrial service.

The "Railodok" services radiate from a depôt which is itself worthy of attention, being the largest of its kind in this country and a vital factor in an organisation which is providing perhaps the greatest demonstration of the potentialities of battery traction.

The garage, which covers an area of 20,000 square feet, was specially designed by Sir Owen Williams, K.B.E., and the construction carried out by Messrs. Humphreys, Ltd., of Knightsbridge, London, S.W.

Accommodation for the whole of the "Railodok" fleet is provided by this garage, which also contains workshops (Fig. 2), charging plant and the offices from which the whole organisation is controlled.

All the work in connection with the equipment of the garage as a charging station was entrusted to Messrs. Drake and Gorham, Ltd., of 36, Grosvenor Gardens, S.W.1, and the electrical apparatus, including switchgear, was designed and manufactured at their works.

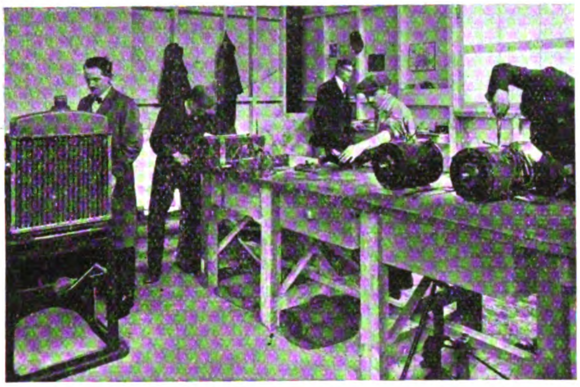


FIG. 2.—WORKSHOP IN THE "RAILODOK" GARAGE. IT IS HERE THAT THE FEW NECESSARY REPAIRS ARE CARRIED OUT.

The problem of providing a suitable battery charging equipment was a somewhat unusual one, and for the benefit of those to whom it may prove interesting we give briefly some of the difficulties and the means by which they have been overcome.

The electricity supply available was D.C. 3-wire 440 volts between outers, taken from the local power station in the Exhibition grounds; while voltage required for each of the vehicle batteries was approximately 55. It was also necessary that any number of batteries from one to one hundred should be able to be charged at the same time. To enable this to be done, three copper conductors, corresponding to the two outers and neutral of the supply, are carried overhead down the centre of the building. Between the outer and neutral of each side of the system three additional copper conductors of smaller section are laid, and a five-wire balancer introduced on each side of the neutral to take care of the "out of balance" current (Fig. 3).

For the purpose of regulating the current supplied to individual vehicles, charging panels (Fig. 4) are provided and connected to the appropriate conductors, each being fitted with an ammeter, ironclad switch-fuse, regulating switch and resistance, and an indicating lamp of distinctive colour. These colours are arranged so that each corresponds to one group of vehicles, and, as all the charging panels are placed along an overhead gallery (Fig. 5), the attendant can, by glancing along the row of panels, ascertain which of his charging circuits are operating and how many vehicles are on each.

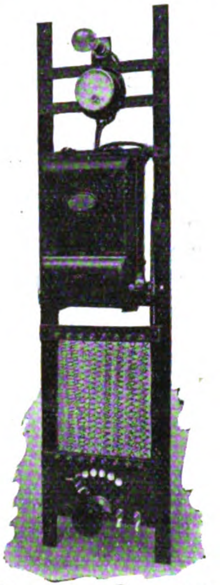


FIG. 4.—ONE OF THE 100 CHARGING PANELS, SHOWING THE INDICATING LAMP, AMMETER, SWITCHFUSE, REGULATING SWITCH AND RESISTANCE.

Any difference in the total current taken by the batteries connected between the same pair of leads, as compared with the amount required by those between any other pair, is dealt with by the balancers previously mentioned, care being taken to keep this "out of balance" current as small as possible by placing the vehicles, as they come in, in the most suitable position, having regard to the state of the particular battery and the charging current required.

As the balancers have a capacity which is greater than the normal charging current of a single battery, it is possible to charge simultaneously any number of vehicles from one to the full number with which the plant is capable of dealing.

The current is led from the charging panels to the vehicles by special insulated flexible leads fitted with charging plugs, suspended from the garage roof immediately over positions taken up by the cars (Fig. 5). This arrangement ensures absence of delay in putting cars on charge.

In order to maintain the maximum service possible, charging arrangements have had to be carefully planned. Broadly speaking, the system adopted is a simple one. During the period when the Exhibition is closed, the trucks are put on charge in two relays

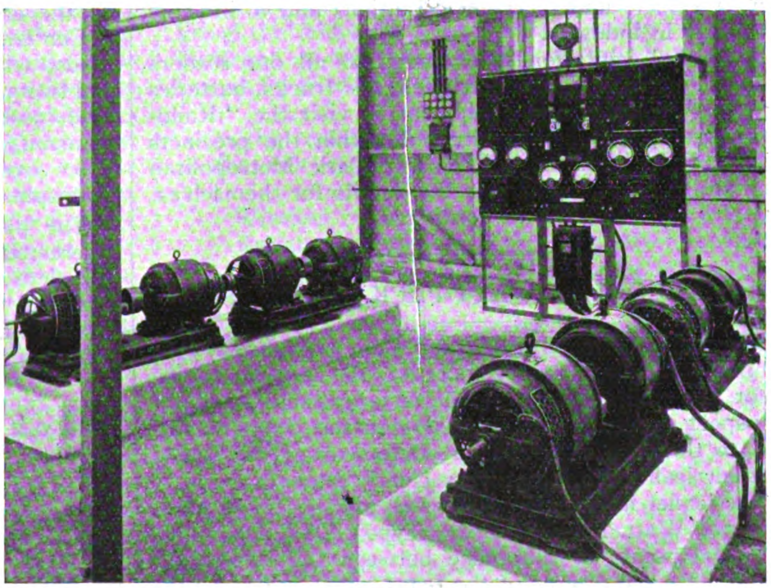


FIG. 3.—THE MAIN SWITCHBOARD AND "FIVE WIRE" BALANCER SETS.

and the batteries fully charged. By day, while the services are running, the trucks return to the garage in batches and receive "boost charges" at intervals which are made to correspond, as far as possible, with periods of minimum traffic demand. During the "boost charging" the rate is several times higher than normal, and it is claimed by the manufacturers that no lead battery other than the "Kathanode" could withstand the high rates of charge and discharge, coupled with the severe jolting over the very uneven surface of the roads.

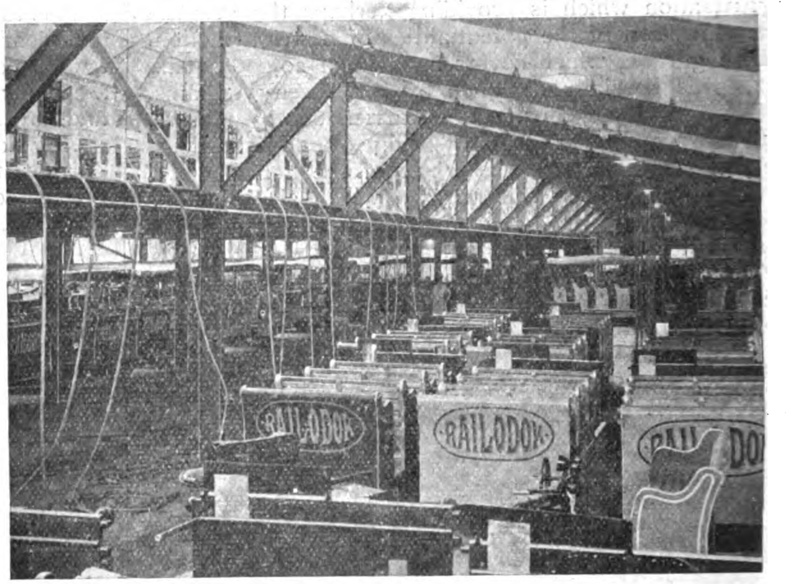


FIG. 5.—INTERIOR VIEW OF GARAGE, SHOWING THE FLEXIBLE CHARGING LEADS. AT THE NEAR END THE LEADS FROM THE CHARGING PANELS (FIG. 4) CAN BE SEEN HANGING OVER THE EDGE OF THE GALLERY AND AT THE FAR END, LOOPED TO THE ROOF AND HANGING IN POSITION FOR USE.

Apart from the battery charging arrangements, there is a very complete organisation in the garage which deals with cleaning, overhauling and running repairs.

Traffic, route and driving staff arrangements are controlled by inspectors and superintendents, who operate on a system very similar to that brought to perfection by the London General Omnibus Company.

In addition to the ordinary passenger services, "Railodok" trucks are performing several interesting duties at the Exhibition. Few visitors will have failed to see the little box-vans which collect cash from the turnstiles and convey it to the bank. There is also the truck with trailers, which, carrying sanitary dustbins, forms part of the Exhibition authorities' very efficient refuse collection organisation in the Palaces of Engineering and Industry. Early visitors at the Palace of Engineering will probably have seen the "Railodok" and trailer, fitted with the familiar tank bodies, which are used by the British Petroleum Company, Ltd., to deliver fuel oil to exhibitors who have plant actually running.

Undoubtedly the British Empire Exhibition has provided an exceptional opportunity to demonstrate the usefulness and success of the "Railodok" as a passenger vehicle under certain conditions and to indicate its utility in industry.

A cordial invitation is extended to all our readers who are interested in industrial electric trucks, batteries or charging plant and equipment to visit the "Railodok" garage, which is situated within the precincts of the Exhibition, near Wembley Park Metropolitan Station, in order to examine the details for themselves.

(To be continued.)

MARCONI 500-WATT PACK STATIONS.

Marconi's Wireless Telegraph Company, Ltd., were probably the first to develop portable wireless equipment for military and mobile use, capable of rapid transport by pack animals. To-day the company are still to the fore with special equipment of this kind, as their leaflet No. 1,031 very clearly shows.

The leaflet in question illustrates and describes Marconi 500-Watt Pack Stations, Types YC2 and ZC1, the chief points of difference between the two types being the wave ranges of the transmitter and receiver, and the provision of alternative methods of signalling. The YC2 set provides for C.W., tonic train and telephony, but the wave-band is limited from 750 to 850 metres, or its equivalent. The ZC1 set provides only for C.W. telegraph signalling, but the waveband covered is 700 to 1,500 metres. The general arrangement of both sets is identical.

For C.W. telegraphy it is interesting to note that the key operates a relay which simultaneously interrupts the grid circuit of the oscillating valve and the primary power circuit.

The receiver may be used for reception of C.W. telephony or spark signals, and consists of a coupled circuit tuner and a four-valve receiver. The first three valves are used as H.F. amplifiers, the fourth valve as the detector.

For transport the complete set is divided into five loads, which include the petrol engine and generator and two 30-foot masts in sections. By adding one more load, 50-foot masts may be carried, which enable the transmitting range to be increased from 200 to 320 miles over flat or undulating country under normal atmospheric conditions.

The booklet (which will no doubt be sent to all interested on request) describes and illustrates the complete stations very clearly and gives general and technical details of both the transmitting and receiving units embodied in the sets and the other necessary component parts required for their operation.

The **G.E. Co.** announce substantial reductions in the prices of Osram Flashlight Lamps dating from July 1, and to assist in pushing this trade the company have issued an attractive folder, No. O.S. 3,380, which embodies the prices of no fewer than seventeen standard sizes of flashlight lamps for voltages from 1.25 to 5.5 manufactured by them. These folders can be had in bulk, overprinted with dealer's name and address, on application to Magnet House, Kingsway, W.C.2, or to any G.E.C. branch. Yet further aid is given by a striking novelty lid to the standard 100-lamp packages. When folded as directed it forms an attractive window or counter display.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of

CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N. 17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

¶ Readers are cordially requested to note that on September 5th "Electricity" will again appear in the familiar apple-green cover of pre-war days. See also special announcement on page 435.

Current Topics.

British Contracts for British Firms.

Taking the far-sighted view, there is no excuse whatever for placing important contracts abroad on the score of lower prices quoted by foreign competitors of British manufacturing firms. Many instances have been recently quoted in the Press of municipal and other contracts being placed outside this country because Continental competitors have quoted prices considerably lower than those quoted by leading British manufacturers. Considered purely on the basis of £ s. d. and the usual payment terms, there would be every excuse for placing orders with the firm quoting the lowest figure consistent with quality. There is a far broader outlook, however, which takes into account our national expenditure on doles, Imperial taxation, local taxation, etc., all of which are inevitably increased with every transaction of this nature in which the work is placed outside Great Britain.

It is false economy to place an order for boilers with Heinrich Fritz and Co. because they happen to have quoted £1,000 lower than John Bull, Ltd., and simultaneously suffer an increased local rate of 1d. or 2d. in the £ to cope with increasing Poor Law administration. It is the old traditional parochial spirit reasserting itself when municipalities are so short-sighted as to accept Continental tenders for their engineering or other requirements. In the circumstances, I very much regret to note that the Hull Corporation Tramways Committee recently accepted the tender of a German firm for 1,500 tons of tramway rails at more than £2 per ton below the figure quoted by a British firm. May they speedily wear out.

It is also disgruntling to note that the Union of South Africa Railways have recently placed contracts for 94 boilers for various classes of saturated and superheated steam locomotives, of which only 22 are to be manufactured by British firms. The remaining 72 have gone to the Continent. The Continental order includes 27 to Maffei, Munich, and 7 to Krupps, Essen. Surely the Great War was not without its object lessons to our Dominions overseas? If our Socialists are so keen on aiding the foreigner at the expense of British prosperity and prestige, why don't they go the whole hog, and take up their residence in what would appear to be the countries of their birth, at the same time investing their savings, if any, in those countries? We certainly do not want them over here, and the British Empire as a whole would be the happier and the more prosperous for their prolonged absence.

Our Telephones.

Complaints are still rife regarding the telephone service, which is stated to be far below the standard expected by modern business men. Delays, wrong numbers, and other irritating accompaniments to the existing manual service are among the complaints levelled at the head of the long-suffering Controller, whilst it was recently stated that no less than five months' delay is involved in securing a telephone at Richmond, Surrey, due to the slow progress of a new underground cable scheme. On the other hand, a prominent Post Office official recently stated that the new automatic exchanges in London will not make their appearance until early in 1926. This will mark the beginning of a new telephone era, and the disappearance of practically all the disabilities under which subscribers now use that indispensable aid to communication. The elimination of the fallible human operator and the substitution of the wonderful and ingenious Strowger director electro-mechanism should bring the telephone service of the metropolis into the forefront of the world's leading telephone systems. Let us be patient, therefore.

Wireless Aerials.

On the vexed question of a tenant's rights in regard to the erection of wireless aerials on his landlord's property, the National Federation of Property Owners has taken a legal opinion which, in effect, maintains that an Englishman's house is still his castle, and that he is entitled to erect the ubiquitous aerial without vexatious interference on the part of his landlord or incurring an extra charge for the privilege. Counsel has advised that the property owner cannot prevent the tenant from putting up wireless poles or attaching wireless apparatus to a house; but, if the tenant does damage in so doing, then he is liable as for damage done in other circumstances. This decision will come as good news to those tenants who have been threatened by their landlords in connection with their latest hobby, and disposes once and for all of the profiteering landlord who seeks to charge an extra rent for what has now been decided is a free perquisite of the occupier.

An Unusual Disaster.

A fatality of novel origin is reported from Germany. At Pierdsdorf, near Eisenach, high-tension current at 2,000 volts was accidentally switched on to the low-tension distribution system supplying the village. Wires commenced to burn, and the church and many houses were set on fire. The startled populace rushed into the streets, and a few men who tried to pull down the wires were electrocuted. The night was spent in saving the church and houses. No details are available as to the cause of the disaster, but one would assume that it possibly had its origin in the breakdown of insulation between the primary and secondary windings of a static transformer in the village sub-station, thus allowing the H.T. transmission voltage access to the L.T. distributing network. It is difficult otherwise to account for the switching of a high voltage on to circuits normally arranged for low tension.

Declining Tramways.

Apropos my recent comments on the future of electric tramways, the general manager's report on the financial position of the L.C.C. tramway undertaking makes interesting reading. Giving evidence before the tribunal on the tramwaymen's claim for better wages and conditions, Mr. A. L. C. Fell recently stated that the L.C.C. system was in a very serious position. The estimated loss for the current year was £316,276. The receipts had been very much down as against the estimate, so that the net result would be very much worse. The granting of time and a quarter might cost at least £59,000. The total expenditure of the L.C.C. on street widening for tramway purposes was about £800,000. Certain fares had been reduced, and the Council had lost less on those than on the fares they had maintained. There is a distinct object lesson in the concluding statement, which should be read, marked and learnt by both tramway managers and electricity supply authorities who are hesitating on the brink of possible reductions in tariff.

Bravo! Crook.

To encourage the sale of municipal electricity, Crook Urban District Council have decided to instal electric light and power free in houses and to lend electric irons to housewives. This is an innovation for County Durham and marks a spirit of enterprise which other more favourably situated undertakings might profitably emulate. If a comparatively remote township like Crook can afford to launch out in this manner, surely some of the financially strong municipalities which at present do their utmost to discourage the use of electricity by their display of apathetic interest could afford to go one better? Nothing discourages a would-be consumer from taking the plunge more than the preliminary out-of-pocket expenditure on wiring and fitting his premises and the purchase of suitable fittings and current-consuming appliances. The Crook scheme overcomes this preliminary obstacle and deserves all the success which is bound to follow in its train.

A Novel Suggestion.

Of all the many proposals put forward from time to time for generating electricity directly from natural resources, that of Mr. H. G. Harley assuredly takes the proverbial biscuit. Mr. Harley's idea is to generate electrical energy in a number of floating power stations resembling inverted chimneys crowned by a circular platform. They would rest on the surface of the water, or in rough seas or bad weather would be completely submerged. Into these structures would flow the warmer upper sea-water, which would circulate around chambers containing compressed air. As it became heated by the water the air would expand and drive turbines, which, in turn, would generate electrical energy. The inventor claims that he can produce 2,387,200 units of electricity per day of 20 hours: the annual value at ½d. per unit being £1,815,266.

The Latest in Wiring Hints.

We live and learn. I have just come across a couple of remarkable "tips" (if one dare call them so), both of which are connected with wiring. A consumer in quite a small house having four or five lamps all told, sent in a complaint about "one of the lights going in and out." It looked like the familiar contact trouble, but when the inspector arrived on the scene the consumer pointed to a frayed portion of the flexible wire just above the lampholder—where constant swinging of a heavy pendant can cause trouble. "Oh yes," said the consumer, "I know the wire's broke. I got a bit of a shock when I felt it. *I tried putting some soap on it, but it hasn't done it much good.*" This ingenious consumer must have had some experience with leaky gas pipes, and apparently he thought that the same treatment would do for electric wiring. I like his reference to the "bit of a shock." Not many people who get an electric shock are so mild or even philosophic!

The second wiring "tip" introduces our old friend Chatterton's Compound in a new rôle. Perhaps that is not quite the correct way to put it, because, although the use of the compound as an adhesive (even on non-electrical things) is by no means novel, the actual circumstances in this case did seem out of the ordinary. For my own part I've long been aware of the useful adhesive properties of Chatterton's (and insulating tape, too), especially in motor-cycles and the like. The peculiar advantage of the compound is that not only is it extremely sticky (who hasn't at some time cussed at its clinging tendency?) but that ordinarily it never really becomes hard. And so on many jobs, especially the attachment of small metal name plates, etc., when screwing or riveting is out of the question, Chatterton's is unbeatable. But judge my amazement when I was informed of certain wiremen who, on rush occasions, stuck ceiling-roses and switches on their blocks with the aid of Chatterton's Compound! Of course, the practice must be condemned, yet I must admit that I have seen cases, say, on plaster walls and so on, where imperfectly attached parts had pulled away under circumstances which might have been obviated if Chatterton's had been used. I hesitate to think of what might happen if those wiremen with the rush tactics had done their *work* in certain places subject to high temperatures afterwards, especially if they had left much "slack" under the blocks. Tragedy or comedy!

ELEKTRON.

Denmark.—A report on the market for wireless apparatus in Denmark has been prepared by the D.O.T., and U.K. firms desirous of receiving a copy, together with full particulars of the Special Register service and form of application for registration, should communicate with the D.O.T., 35, Old Queen Street, London, S.W.1.

AN INTERNATIONAL RADIO WEEK.

The transatlantic broadcasting of last year is to be repeated this autumn, it is hoped, on an international scale, subject to the full co-operation of the B.B.C., who are already interesting themselves in the proposals, and their ultimate attitude, it is believed, will depend solely on the popular demand. In America a full week is to be set aside from the 23rd to the 30th November under the designation "International Radio Week." No one will underestimate the importance of fostering between nations, and the two great English speaking nations in particular, the spirit of good will, appreciation and understanding, and it is claimed that no other known means of attaining this end can compare with wireless intercourse. That this is far from overstating the case will be realised by those who are aware of the rapid and continuous advance of the science. Even last year, although the transmissions were purely experimental, the voice from across the Atlantic was made clearly audible, and listeners will not readily forget the remarkable sense of proximity and intimacy produced by those early efforts.

With the object of maturing comprehensive plans, the Radio Trade Association of America has for some time past been in communication with the Wireless Retailers' Association, of 70, Finsbury Pavement, E.C.2, and the latter body has been in conference with Mr. Hugh S. Pocock, the editor of *The Wireless World and Radio Review*, who, with Mr. Arthur Lynch, of *Radio Broadcast*, in America, and, in conjunction with officials of the B.B.C., had charge of the arrangements with America last year. The editors of these two journals have been asked to undertake the work again this year. It is proposed to arrange programmes of speeches, entertainments, etc., etc.

At the suggestion of Messrs. Clifford and Clifford, hon. secretaries of the Wireless Retailers' Association, arrangements are being made whereby Continental stations may participate in the scheme this year, and the organisation for this part of the movement is being undertaken by that body. By reason of the comparative nearness of a number of the high power stations across the Channel, many amateurs will be able to pick up these transmissions direct, but it is believed that the re-broadcasting by the B.B.C. will enable most users of even crystal sets to hear quite distinctly. Owing, however, to the limitations at present imposed on transatlantic transmissions by distance, daylight and atmospherics, preference will be given to America as regards times, etc.

The organisers trust that all who can will give their assistance in making the inauguration of what they believe will come to be a permanent international institution a marked and memorable success.

Price lists of electrical snap switches and incandescent electric lamps for export have been issued by **Mr. Alfred Barth**, 179, Rue Gaucheret, of Brussels, who is anxious to build up a trade in these goods with the British Colonies.

We have received from **Crompton and Co., Ltd.**, electrical engineers, of Chelmsford, lists giving illustrations and details of their latest type high tension A.C. draw-out cubicles or truck type switchgear as shown on their stand at Wembley. Also details of the plant manufactured by the company which is at present installed in various parts of the Exhibition. These lists will prove of interest to all central station, power and lighting engineers.

TELEGRAPHY.*

Being solutions to the questions set at the Grade I. examination in Telegraphy held by the City and Guilds of London Institute, on April 30, 1924.

(*Continued from page* 422.)

Q.—Describe, with a sketch, the construction of a polarised sounder. What advantages does it possess over the ordinary non-polarised sounder?

A.—Fig. 7 shows the polarised sounder designed by Mr. C. C. Vyle.

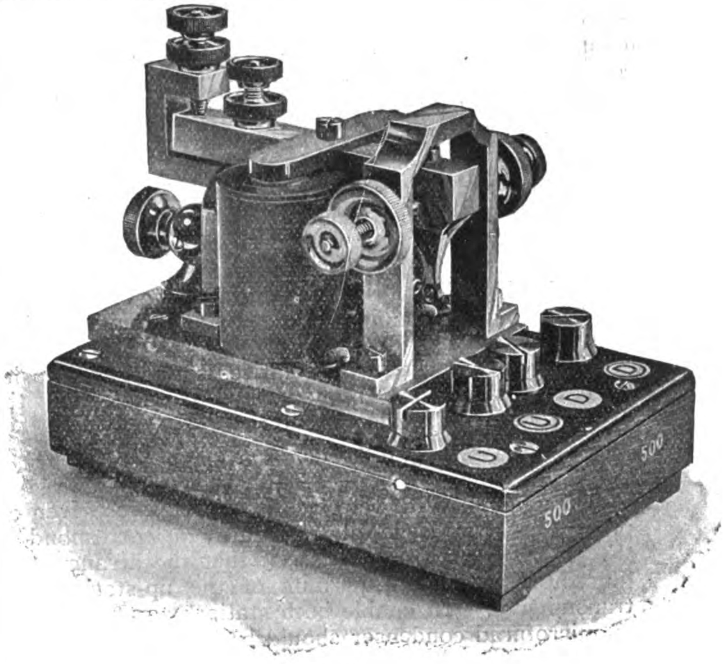


FIG. 7.

It will be seen that in appearance and construction the instrument is similar to an ordinary pony sounder. A horse-shoe magnet is placed in the base of the instrument with its poles immediately below the cores of the electro-magnet. Each of the coils is wound to a resistance of 500 ohms, the ends being led to four terminals, by means of which the coils may be joined in series, in parallel, or differentially. The distance between the cores and the armature, when the latter is up and down, is 24 mils and 8 mils respectively.

The armature is set neutral by putting sufficient tension on the spring to counterbalance the effect due to the magnetism induced in the cores by the permanent magnet, the armature remaining against the upper or lower stop when moved by the hand.

When a current flows in the coils in the marking direction the magnetism in both cores is strengthened, the tension on the spring is overcome, and the armature is attracted. When the current flows in the spacing direction, the magnetism of the cores is weakened, the spring reasserts itself, and the armature flies back.

In the latest pattern of this instrument the adjustable screws between which the lever plays have been replaced by fixed stops, so that the only adjustment required is the tension of the spring. The thumb-screws by means of which the lever is pivoted have also been replaced by ordinary screws to keep the armature in alignment. For single current working the instrument is wound with one coil of 5,400 ohms resistance and is provided with a shunt of 27,000 ohms, giving a combined resistance of 4,500 ohms. The tension of the spring is increased so that the lever rests against the upper stop.

---

* Books recommended are:—*Questions and Solutions in Telegraphy and Telephony, Grade I.*, by Few (Rentell, 5s. 10d., post free), and *The Telegraphists' Guide*, by Bell and Wilson (Rentell, 3s. 10d., post free).

The advantages of the Vyle polarised sounder over the ordinary sounder are:—

(1) The working current is smaller, being only 10 milliamperes for the Vyle sounder, as against 20 to 26 milliamperes required to work an ordinary pony sounder (900 ohms).

(2) The Vyle sounder can be worked single current double current, and by condenser impulses. An ordinary sounder is single current only in action.

(3) Working with the Vyle sounder, relays and local batteries may be dispensed with.

(4) The high inductance of the coils (62 henries) neutralises to some extent the static capacity of the line, thereby increasing the speed of signalling.

(5) Owing to the mechanical inertia of the armature, the inductive effects due to neighbouring circuits are not felt so much as is the case with circuits worked with relays.

(6) Circuits worked with polarised sounders are easier to balance than are relay-worked circuits, and the working margin is also greater.

(To be continued.)

Correction.—With reference to the answer given on p. 357 of our issue of 11th ult., a correspondent (E. J. D., Southall) points out that the arrangement illustrated in Fig. 4 permits of the up-station only transmitting. To enable both stations to transmit the 10 microfarad condenser should be inserted in the lead from the centre back terminal of the down-station key; or, better still, a condenser should be inserted at both stations—one in the line lead from the right terminal of the up galvanometer, the other in the line lead from the U-circle terminal of the down relay.

Answers to Correspondents.

JOHN J. WUD. WITENHAGE (South Africa).—We would advise you to write to the makers of the mercury meters for details of cleansing the mercury. As a general rule they are willing to assist users, since foreign matter such as aluminium is likely to make the mercury dirty. We have not had a question of this nature in our Questions and Answers Competition. We are, therefore, publishing it in the near future in order that you may have the benefit of our experience.

NOTE.—We heartily invite all readers in the Dominions and abroad to send along any problems they may have. We have an expert technical staff which is always at the service of any reader. We would also appreciate details and articles dealing with central station development, and interesting lighting installations, for use in this journal. Photographs should accompany all matter, which we undertake will receive our earnest consideration.—ED., ELECTRICITY.

A civilised state is that in which a man labours endlessly to buy clothes for his womenfolk.

THE ELECTRICAL KITCHEN FOR PRIVATE HOUSES.*

BY PROF. H. BOHLE, M.I.E.E.

(Continued from page 428.)

11. THE HEATING OF WATER.

We are mainly concerned here with the heating of comparatively small quantities of water. The solution of this problem has not been always satisfactory, largely on account of the low efficiency and the employment of unsatisfactory elements.

To obtain a high efficiency we must see that it is not necessary to heat up the whole tank every time water is required, and that a small quantity of hot water may be obtained without having to heat a tank full of water. This means that the lagging must be very effective, and the heating of the water must take place in a small side tank. The heating element should be light and offer a very large surface to the water surrounding it.

In a heater constructed by the author on these principles the element consists of a flat copper tube with a thin spiral nickel-chrome wire insulated by means of silica tubes. By removing a few nuts the element can easily be taken out and a new wire put in, work which even the intelligent layman should be capable of performing. The heating tank carries at its upper end an automatic switch which interrupts the current when the temperature has reached, say, 80 to 90 degrees, and inserts the switch once more when the temperature of the water has dropped to, say, 50 or 60 degrees. With good lagging the loss of temperature should not exceed 1.5 degrees C. per hour.

Before the water passes into the geyser it is conducted through a set of pipes on the top of the roof. These pipes are painted a dead black for absorbing the rays of the sun. With a suitable position for the pipes it should be possible to heat sufficient water for an ordinary household during seven or eight months of the year, so that only during the winter months, say, May to September, energy is required, making the annual efficiency a very high one.

The following are some results obtained with a geyser lagged with four layers of corrugated packing paper:—

For an average temperature rise of 24 degrees C. of the whole water in the tank (40 litres), the efficiency, when heating from the cold state (17 degrees C.) and before the tank was lagged, was 78 per cent.; for a rise of 50 degrees C. it was 73 per cent. After lagging with four layers of paper the results were:—

Temp. rise.	Efficiency.
25 degrees C.	82 per cent.
46 ,,	80 ,,
57 ,,	74 ,,

It must be remarked that these efficiencies include the losses incurred in running all the water out into a bath and heating up the latter (the running out took five minutes). We might call this the housewife's efficiency. If we measure the temperature of the water before the water has run into the bath the results are increased by 10 to 15 per cent. At the same time it will be noticed that, if the water has to be heated from the cold state every time hot water is required in quantities, the effect of the lagging is not so very marked. The reason for the high efficiency of the unlagged tank is to be found in the light weight of the tank, and the large heating surface of the elements.

---

* Abstract of paper read before the S.A. Inst. of Electrical Engineers.

When the tank had been heated up to an average temperature of about 70 degrees C. and water was drawn off at regular intervals of 15 minutes, measuring the temperature of the water again in the vessel and not in the tank, the efficiency worked out at 90 per cent. The quantity drawn off was 5 litres.

In a 24 hour cooling test it was found that the temperature dropped on an average $1\frac{1}{3}$ degrees C. per hour.

It must be remarked here that the tests were carried out under somewhat disadvantageous circumstances, as the tank had to be placed in an open doorway, where there were considerable draughts. In a bathroom the results should be even better. The geyser has the advantage of cheapness, and yet will appear neat and work satisfactorily. The test element consumed 1,347 watts.

12. COST OF COOKING BY ELECTRICITY.

The automatic electric oven is undoubtedly the most efficient utensil on the market, and it possesses the advantage of requiring no supervision. In our household all the cooking is done by electricity, also the ironing of all the washing, though the washing itself has hitherto been boiled with wood. A good deal of the baking is also done by electricity, as the external monthly bread bill never reached ten shillings for a household of five persons. The meter readings since November, 1922, were as follows:—November, 132 units; December, 101; January, 134 (two visitors for whole month); February, 108; March, 103; April, 117. This is an average of 117 units per month. At two pence per unit for the first 100 units and $1\frac{1}{2}$ pence thereafter this works out at 18s. 10d. per month. This is about ten shillings less than our coal fuel bill used to be. The consumption of the automatic oven may be seen from the following example:—

Bottom dish:

Weight of vessel $10\frac{3}{4}$ ounces.
Weight of beef 4 lb.
Weight after roasting 3 lb. $14\frac{1}{4}$ ounces.
Shrinkage thus less than 3 per cent.

Middle dish:

Weight of vessel 10 ounces.
Weight of potatoes 1 lb. 10 ounces.
Weight of water 1 lb. 1 ounce.

Top dish:

Weight of pot and lid 8 ounces.
Weight of rice 6 ounces.
Weight of water 1 lb. 6 ounces.

The automatic switch pulled out when the consumption of energy had been 0.70 unit. The power consumption of the hot plate of the oven is about 900 watts.

These results must be considered very favourable. By sealing one pot up with another one above it little energy and food is wasted. The shinkage of meat is almost negligible, as what is drained out of a joint appears in the gravy. On an open coal fire the shrinkage may be as much as 30 per cent. The same food cooked in the rectangular automatic oven required about 70 per cent. more current, which shows that from the economy standpoint the circular oven is the correct one, as one would imagine. But people have to be trained to it, as they are not used to leaving the food and the oven to itself. For old and tough goods the slow cooking in a hay box with an automatic switch regulated by heat cannot be beaten. I certainly think that this type of oven will become increasingly popular, as it is an ideal oven for people who cannot afford many or any servants.

(*To be continued.*)

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 186.

When viewing a cinematograph picture, the wheels of a carriage appeared to be turning backwards. Can any reader explain this to me?—"INQUISITIVE."

QUESTION NO. 187.

I wish to use a 100 volt., 3 amp. D.C. motor on 210 volts. Can any reader tell me how to construct a resistance to enable this to be done, since I am told that this is the most economical way of doing it?—"H. W. MAY."

(*Replies to Questions Nos.* 186 *and* 187 *must be received not later than August* 30, 1924.)

Reviews of Books, &c.

[*Books noticed in this column will be sent from* ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage* (*minimum* 2*d.*), *and orders will be appreciated.*]

ELECTRIC WIRING DIAGRAMS FOR MOTOR VEHICLES. By M. A. Codd. Sup. Roy. 8vo, 96 pp., 92 diagrams. Cloth. (Spon, 3s. 6d. net.)—This is a book which will, we expect, soon be in the possession of every public garage owner in the kingdom, as well as in that of many private owners, for the simple reason that it is so thoroughly comprehensive. It has no text, just the diagrams, but they are very clear and show accurately the circuits relating to lighting, starting and ignition whether by battery or magneto, of practically every make of British car and most of the leading Continental and American types. What is more, it deals with many of the older models which are still in regular use, and for that very reason it covers a wider ground than if it were confined to the newest and most up-to-date types only. Altogether it fills a much needed want, and can be cordially recommended.

AN INTRODUCTION TO THE STROWGER SYSTEM OF AUTOMATIC TELEPHONY. By H. H. Harrison, M.I.E.E. Demy 8vo, 146 pp., 161 diagrams. (Longmans, 7s. 6d.

net.)—As an author Mr. Harrison is noted for the clear way in which he explains his theories and facts to his readers, whether they be junior students of mathematics or engineers in the higher branches of the telegraph service, and this introduction to the automatic telephone system which is now being adopted throughout London as well as in Tokyo and many other leading cities of the world, is a simple and eminently practical text book which is certain to appeal to all the rising generation of telephone engineers as well as to many of the older brigade who wish to make themselves conversant with the very latest phase of the Strowger system. Mr. Harrison takes his readers through the fundamental principles of automatic telephony with extreme care, and with the aid of a splendid series of diagrams he has produced a work which we can most cordially recommend to our readers, even though he does say in his last paragraph but one that, in his opinion, "in a few years from now the Strowger system will, due to development work, be utterly unrecognisable when compared with to-day's standards." For "to-day's standards," this book is the last word on what is now being installed in London.

Various Items.

Change of Address.—Mr. Howard Little, who was formerly a regular contributor to the columns of this paper, begs to state that after August 28, 1924, until further notice, his address will be: 46, Grettisgata, Reykjavik, Iceland.

Tenders Accepted.—The G.P.O. has placed an order for 150 protectors with the Edison Swan Electric Co., Ltd.——The L.M. and S.R. have accepted the tender of Siemens and English Electric Lamp Co., Ltd., for the supply of a large quantity of Siemens vacuum train lighting lamps.

Prizes Worth Winning.—We would direct the attention of all our readers to the advert in the current issue of the St. Helen's Cable and Rubber Co., Ltd., of Slough. The information gained should prove of value to all installation contractors, and we are looking forward to it with keen interest.

Quotations Wanted.—The City of Toronto invites tenders for the supply and delivery of one 40-million imperial gallon centrifugal pump and electric motor or two 20-million imperial gallon centrifugal pumps and electric motor.——The South African Rys. and Harbours Board at Cape Town are calling for tenders for a quantity of incandescent lamps.——The Ministry of Public Works at Buenos Aires are calling for tenders for the supply and delivery of 25 steam travelling cranes and one stationary electric crane. Specifications, etc., from the D.O.T. (Room 52), 35, Old Queen Street, London, S.W.1.

Electric Circuit Breakers.—A pamphlet bearing this title and the words, "Why they are essential," has just been issued by Messrs. George Ellison, of Perry Barr, Birmingham. It contains six pages of interesting data dealing with the subject of circuit breakers and fuses, and should most certainly be read by all electrical installation contractors and engineers in charge of plant, to whom copies will willingly be sent on application.

United States.—The report on the commerce of the U.S.A. has just been issued by the D.O.T., and may be obtained from H.M. Stationery Office or ELECTRICITY office, price 3s. 0d. post free. On pages 69 and 70 much interesting information is given in regard to the production of electrical energy in the United States, and also in regard to the manufacture of electrical machinery and equipment for both home and export use. We notice that the American General Electric Co. has acquired secure control over the Canadian Corporation of the same name with a view to expanding the sales of its products in the various parts of the British Empire, obtaining the advantage, wherever possible, of preferential tariff rates. This is a matter which will attract the attention of home manufacturers in this country, who have to compete for their export trade in all parts of the world. We notice also that important works extensions are being made by the American G.E. Co., the Westinghouse Co., and the Western Electric Co., in order to cope with the expected increased demand.

Trade Notes.

Catalogue No. 410 of Rowenta Electric Cooking Appliances has just been issued by the **Welsbach Light Co., Ltd.**, King's Cross, London, W.C.1, and as it contains details and illustrations of many lines for which there should be an increasing demand during the coming season, trade dealers and contractors should write for it at once.

Another beautifully illustrated pamphlet dealing with illuminating engineering has just been issued by the **Benjamin Electric, Ltd.**, of Tariff Road, London, N.17. It contains illustrations of ideal lighting for various classes of work, and as such will be of direct interest and value to every installation contractor, to whom the company will be pleased to send copy on receipt of the usual trade application.

Now is the time when dealers in wireless supplies should make a point of preparing for the busy season, which is certain to come along shortly, and, in this connection, we would most strongly advise them to write at once to the **Mullard Radio Co.**, Dept. E.E., at Nightingale Works, London, S.W.12, and ask for the company's show-cards, dummy valves and counter leaflets. They are just the thing to help the enterprising trader to do still more business.

Folder R7444, which has just been issued by the **B.T.-H. Co., Ltd.**, gives particulars of their Radio Valve type B3 for rectification and amplification, and, as such, will appeal to all dealers in wireless supplies, to whom copies will be sent on application.

We have received from the **Edison Swan Electrical Co., Ltd.**, a copy of their complete catalogue. This is a very comprehensive work made up of the various individual sections of which notices have appeared from time to time in our columns. The sections referred to deal respectively with lamps, accessories, instruments, wires and cables, house wiring systems, wireless goods, fans, and various other items, and as they are bound together with a neat thumb index arrangement which permits of easy reference, the catalogue is one which is certain to be appreciated by all installation contractors and dealers in electrical supplies, to whom it will be sent on proper trade application.

Austria.—In the report on the commercial situation in Austria, which has just been issued by the Dept. of Overseas Trade, there is an interesting article on page 18, dealing with water power and electrification, in which it shows that orders for plant and material can be obtained by British manufacturers if the London financiers can see their way to assist in promoting the various hydro-electric schemes, for which there is apparently a profitable demand in many districts. The price of the pamphlet is 1s. 8d. net, post free, from H.M. Stationery Office or ELECTRICITY office.

Sample Pair Sent on Approval for 8/6
Made of Pure Para Rubber, soft and durable and unaffected by climatic conditions
DAVID MOSELEY & SONS, Limited.
ARDWICK. MANCHESTER.
MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

AUGUST 29, 1924

CONTENTS.

	PAGE
Important to All Readers	447
The Conference on Illumination at Wembley	447
A New Mechanical Boiler Flue Cleaner	448
"The Place of Electrical Engineering in the Training of Engineering Students"	449
Current Topics	453
Telegraphy	455
Electrical Engineering—Final Grade	455
The Electrical Kitchen for Private Houses	456
A New Wireless Valve	457
Questions and Answers by Practical Men	457
The "Railodoks" and Launches at Wembley	458
Various Items	458

IMPORTANT TO ALL READERS.

September 5 is an important date in the annals of this journal, since upon that day ELECTRICITY will reappear in its original coloured cover of apple green. Readers will remember that, owing to the difficulty of obtaining coloured paper during the war, we were reluctantly compelled to adopt a white cover. We never did like the white cover, and, from letters received from different parts of the world at various times, we are aware that our readers shared our dislike. There is something, after all, in the cover of a journal which appeals to its readers. It is something distinctive which makes it stand out from among others as *the* journal. So, dear readers, look out in future for the apple green one in your newsagents' shops and upon railway station bookstalls.

In that issue of ELECTRICITY we are commencing what we hope will be a popular feature with our readers, and which will enhance our reputation as a PRACTICAL TRADE JOURNAL. The feature is, briefly, as follows :—

We are going to devote a certain amount of space each week to "PRACTICAL ELECTRICAL ENGINEERING HINTS." We feel sure that in the whole of the branches of the electrical engineering industry there are various ways of doing certain things, some of them being better than others. At times an armature winder has to make a new tool, or an electrical fitter has to do a job in a special way, etc. It is these hints we are after, and we invite all readers to send them along, with illustrations. All published matter will be paid for at our usual rates. In this way readers will not only be benefiting themselves in a financial way, but they will be assisting their fellow-workers by giving them the benefit of their experience.

THE CONFERENCE ON ILLUMINATION AT WEMBLEY.

There was an excellent and representative attendance at the Conference arranged by the Illuminating Engineering Society at the British Empire Exhibition on August 12.

During the first stage of the proceedings the chair was occupied by Mr. J. W. Beauchamp, Director of the Electrical Development Association. The first item on the programme was an address by Mr. L. Gaster, who gave a summary of developments at two recent congresses held in Geneva, the First International Conference on Industrial Hygiene, and the gathering of the International Illumination Commission. At both meetings industrial lighting was well to the fore. An excellent opportunity was afforded of interesting hygienic experts in lighting, and the various results of inadequate illumination—eye-strain, fatigue and inefficient output—were strongly emphasised. A paper by Dr. Stassen gave convincing evidence in support of the view that miners' nystagmus is due to inadequate lighting in mines. As a result of this conference it is hoped that regular exchange of views between hygienists and experts on lighting will be arranged. It was also suggested that the International Illumination Commission should bring before the International Labour Bureau of the League of Nations any problems in regard to lighting which were particularly pressing, so that they might be brought simultaneously before the notice of the chief Governments concerned.

In dealing with the International Illumination Commission's work, Mr. Gaster referred specially to several papers read by American representatives explaining the widespread scheme of co-operation between manufacturers and supply undertakings in matters of illumination, the organisation of demonstrations, essay competitions for children in schools, etc. He mentioned, as an indication of the need for impartial and authoritative guidance of investigations, that it has been decided to place researches on the results of better illumination under the National Research Council, and he concluded by urging the need for a comprehensive educational scheme in this country with a view to promoting public appreciation of the benefits of good illumination.

There was a very representative discussion of Mr. Gaster's address, Mr. W. R. Rawlings, Mr. J. Eck and others urging the need for educational measures on a large scale. Miss Squire (Home Office Factory Dept.) explained the steps that had been taken in connection with industrial lighting, and mentioned that the new Factory Act now before Parliament contained a requirement of suitable and adequate lighting in general terms. She had found amongst employers a general desire to learn more about lighting, and any steps which the society could initiate towards education in lighting matters would be very welcome. Mr. C. Raphael spoke from the standpoint of the consulting engineer, and Mr. W. T. Dunn (Institution of Gas Engineers), Mr. L. E. Buckell, Mr. W. E. Bush and others all endorsed the speaker's remarks in regard to the need for co-operation in propaganda work. Following the discussion, a resolution was proposed by the chairman (Mr. J. W. Beauchamp), seconded by Capt. W. J. Liberty (Institution of Public Lighting Engineers) and supported by Mr. Geo. Herbert, approving the proposal of the Illuminating Engineering Society to initiate a scheme for promoting public appreciation of the benefits of good illumination, and recommending that the society should receive every support in their endeavours.

The resolution having been carried unanimously, Capt. W. J. Liberty occupied the chair, and a paper on "Illumination of Highways from the Motorist's Point of View" was read by Mr. Edward H. Fryer (head of the Road Dept., Automobile Association). In the course of his paper, Mr. Fryer outlined the main requirements of good street lighting, emphasising the need for avoidance of glare and troublesome shadows, sudden changes in illumination at the boundaries of areas, and other defects. He also discussed the problem of providing signal lights on road obstructions, pointing out the general understanding amongst motorists that red lights should be passed on the "off-side." Some means of indicating clearly when an obstruction was to be passed on the near side was very necessary, and he suggested that central obstructions should be indicated by a green light. In the subsequent discussion there was general agreement as to the need for better public lighting, Mr. E. D. Allen pointing out that at present motorists were compelled, for their own safety, to use powerful headlights, which would be unnecessary in really properly illuminated streets. In this connection Mr. W. R. Rawlings quoted an amusing extract from a notice of a local authority, which ran, "All vehicles must have lights when it is dark. (N.B.—When the street lamps are alight it is dark.)"

During the concluding part of the conference Mr. Gaster took the chair, and a couple of papers by Mr. Haydn T. Harrison and Mr. G. L. Jennings were then read dealing respectively with the electric and gas lighting of the Exhibition. This item illustrated very aptly the methods of the Illuminating Engineering Society. Both authors described the respective methods without reflecting on the other, and the contrast in the aims of the two sections of the Exhibition was most interesting. Mr. Jennings pointed out, what is common knowledge, that an unusually high standard of illumination has been attained in the Amusement section. Mr. Harrison's paper (which in the author's absence through indisposition was read by Mr. C. H. Cunliffe) described the methods of flood lighting employed and the special projectors, which had been so designed as to get the greatest concentration of light yet obtained from an incandescent filament. Mr. Harrison explained that the original scheme of lighting had not been carried out in its entirety, and consequently the effect was not in all respects what was initially contemplated. He drew attention to the low intrinsic brightness of the familiar diffusing spheres used in the grounds, notwithstanding their high candle-power, and mentioned that the interior lighting problems included treatment of some of the largest buildings in the world.

There was general agreement amongst the audience that in some respects, notably in the attempt to avoid the crude glare characteristic of past exhibitions, the lighting marked a distinctive advance. At the same time, it was suggested that more impressive and striking results would have been obtained if the whole lighting scheme had been considered at an earlier stage and better facilities for the supply of electricity for purposes of illumination had been sanctioned by the authorities.

It is defeat which educates us.

A NEW MECHANICAL BOILER FLUE CLEANER.

(From a Correspondent.)

It is well known that in the working of cylindrical boilers, and to a lesser extent in the case of small water-tube boilers, one of the most unsatisfactory operations is the hand-cleaning of boiler flues, which is a dirty and laborious job. From the labour point of view it is costly, and in the very near future it will be difficult to find men to undertake it at all. Also, the present hand method of cleaning at intervals of, say, six months results in a considerable loss of efficiency, because the gradual accumulation of flue dust impedes the draught by reducing the effective area of the flues, and there is in addition the gradual formation of a deposit of soot and dirt on the boiler plates which constitutes an extremely effective non-conductor of heat, the combined effect often being very pronounced.

It is interesting to note, therefore, that a simple and ingenious apparatus known as the "Vulcan" mechanical soot cleaner has been perfected by Messrs. The Boiler Tube and Flue Cleaner Co., Ltd., 238B, Gray's Inn Road, London, W.C.2, by means of which the operation of cleaning boiler and economiser flues can be carried out mechanically at short intervals—say, once per day—thus keeping the flues and boiler plates and tubes in a permanently clean condition, doing away with hand labour altogether. This new cleaner consists essentially of a series of lengths of small-bore steam pipe laid on the bottom of the entire flue circuit to the chimney, including, of course, the economisers, having steam nozzles at short intervals. The supply of steam to these nozzles is controlled by a patent manifold valve placed, say, over the side flues of a cylindrical boiler, or in any other convenient position, which is operated generally once per shift. The design is such that the steam is turned on for a few seconds, first to the nozzles in the boiler furnace tubes and bottom flue section, blowing in front of it all the light dust that has accumulated from the previous shift. Then automatically, by the action of the manifold valve, the section of nozzles is shut out and the next comes into operation, and so on, in this way, the whole of the dust in the entire flue circuit being blown right out of the plant, either into a receptacle chamber at the end or up the chimney. The total time of operation is two minutes, and the amount of steam used is extremely small; whilst for the same reason there is no trouble with damp flues, and the amount of material blown out of the chimney is excessively small even in the case of inferior and high ash-content fuels.

Further, the apparatus seems to be extremely simple and almost impossible to get out of order, whether by the heat or the dust—quite unlike some of the types of complicated suction apparatus working at high speed that have been proposed from time to time. No cold air is admitted; it is claimed that the annual inspection of a Lancashire boiler can be made ten hours after pulling out the fires; and there is also a device of a drain cock, normally open, in the steam supply pipe, so that, when not in operation, no steam or water can leak into the flues. It is an interesting development in the technique of steam generation that much attention is being given to the smaller boiler plants, which, of course, in the aggregate consume an enormous amount of coal.

"THE PLACE OF ELECTRICAL ENGINEERING IN THE TRAINING OF ENGINEERING STUDENTS."*

This paper is not concerned with the training of electrical engineers, but rather with the training of students entering other fields of engineering. It cannot be denied that electrical engineering is interwoven with every other branch of engineering and will be increasingly so in the future. It is therefore necessary to consider not merely the present relationships between the different branches of engineering, but to look ahead and anticipate as far as possible the engineering prospects of ten to twenty years hence. Little prophetic power suffices to foresee enormous developments in the applications of electricity. Apart from the supremacy of electrical transmission of energy over any other system, the efficient generation of energy will become a greater economic necessity. Even at the expense of using a hackneyed expression, it can be confidently stated that we are entering upon an electrical age; and it is with this realisation that the training of students preparing for mechanical, civil and other branches of engineering should be considered.

It is an astonishing fact that there are at the present time colleges and universities where it is possible to qualify for a Diploma or Degree in Engineering without the slightest knowledge of electrical technology. Take, for instance, the requirements for the B.Sc. Engineering Degree of the London University. A candidate can take such a group as :—

Theory of Machines and Machine Design,
Theory of Structures and Structural Design,
Strength and Elasticity of Materials,
Advanced Theory of Machines and Machine Design, or Advanced Theory of Structures and Structural Design and Mathematics.

Can anyone suggest a more limited field than is involved by this curious combination? No thermodynamics and no electricity! The writer ventures to state that the narrow outlook on engineering that results from the study of such a group of subjects is unworthy of the hall-mark of an engineering degree.

Has this narrowness of training not been largely responsible for the comparative sluggishness with which electricity has been applied in various directions, and is it not often reflected by the prejudiced opinions expressed from time to time against particular electrical developments? Can a mechanical engineer, for instance, form a reliable judgment upon the best types of electric motors for various industrial applications if he is not conversant with their characteristics? How can he judge, say, the best speed for an induction-motor drive if he is ignorant of the influence of the number of poles upon the power factor of the motor? A civil engineer unacquainted with the principles of electrical generation and transmission cannot do full justice to a hydro-electric scheme. Who can tell the extent of the delay to the electrification of railways, to electric propulsion of ships, etc., that has been due to prejudiced notions of engineers who are not conversant with electrical technology?

It is not maintained that the electrical training of a mechanical or civil engineer should be such that he can dispense with the services of the electrical engineer, but simply that it is impossible for such a person to form a sound judgment on any matter involving the application of electricity unless he has a knowledge of the underlying principles.

One important function of a technical institution is to give the student the groundwork for attacking engineering problems with which he may subsequently be confronted. He is not turned out as a finished article, but merely supplied with the tools wherewith to pursue his own course. It is unhesitatingly maintained that these "tools" should include a knowledge of electrical engineering. If a person is not given a thorough grounding in this subject while at a technical institution, he will find it the most difficult of all the branches of engineering to pick up later on in life. It is even maintained that owing to this difficulty the time devoted to electrical engineering by engineering students in general should be greater than its relative importance might indicate. Furthermore, the study of electrical problems, apart from its utilitarian aspect, provides an excellent mental exercise.

We will now consider the minimum of electrical engineering that may reasonably be included in the day courses preparing for a Diploma or Degree in Engineering. In many institutions it is the practice to devote about four or five hours a week to electrical technology during the second year of the course. In a few cases, a short intensive course is given some time during the second year. The latter arrangement has a very serious defect from the standpoint of the average student in that he is given very little time to digest the subject. This difficulty applies to electrical work more than to any other engineering subject owing to the student being initiated into a fresh "atmosphere" and the consequent necessity of forming new conceptions; and particularly does the difficulty apply to the study of alternating currents. The writer ventures to state that at the end of one year's course in electrical engineering comparatively few students have obtained a thorough grasp of the subject. They may be able to work out numerical questions and to reproduce correctly much of what they have been told, but the formation of physical conceptions concerning electrical phenomena is not an instantaneous, but rather a slow, growth, in the case of the majority of students. This feature of the study of electrical engineering is so marked that with many students the effect of a short intensive course is to produce a permanent loathing of the subject.

One method of overcoming the difficulty just discussed is to include electrical engineering as an integral and essential part of the third-year course. Such procedure enables the lecturer to deal in an adequate manner with the various important problems arising out of the study of alternating-current circuits and machines. Such an arrangement has been adopted by a few technical institutions; for instance, at the Heriot-Watt College, Edinburgh, the third-year mechanical and mining engineering students are given an hour's lecture a week on the "Practical Application of Electricity," followed by two hours electrical laboratory work. At the Royal Technical College, Glasgow, the courses for the third-year mechanical and electrical engineers are almost identical, it being maintained that "modern industrial conditions require that those who have adopted one branch shall have a knowledge of the other." Electrical engineering is also included in the third-year courses for mining and naval architecture. At the Brighton Technical College we go so far as to include about nine hours of electrical engineering per week in the third-year course for mechanical engineers, about four hours being devoted to laboratory work.

---

* Paper read by Edward Hughes, B.Sc., before the Association of Technical Institutions, July, 1924.

The question naturally arises as to what must inevitably be omitted to make room for the electrical work. The last thing we desire is to increase the burden of our engineering students. They are so heavily loaded at the present time that in most cases they suffer from mental indigestion. But is it not possible that many of our technical colleges encourage too much specialisation? How often it occurs that a student enters quite a different branch of engineering from that which he originally intended! A similar change frequently happens later on in life. Each career may be regarded as a voyage over an uncharted ocean, and the best preparation that can be given for such an adventure is to learn how to utilise one's limited knowledge for surmounting the various difficulties that may be encountered.

The writer is of the opinion that much in the way of empirical formulæ and data with which students are burdened—especially in mechanical and civil engineering subjects—could be omitted if examiners would only bear in mind that their function is not to test the candidates' memories, but rather to find how much of the subject they have understood and digested. After all that may be said and done, a student cannot be taught everything during his technical training; and the person who does not continue his studies after leaving his Alma Mater is not worthy of consideration.

Even if technical institutions were to attach greater importance to electrical engineering in their diploma courses, the case of those institutions preparing for the engineering Degree of the London University has still to be considered. Attention has already been drawn to the absurdity of the present regulations, and the writer submits in Appendix I. three alternative schemes, each of which broadens the scope of the examination and ensures that every candidate possesses satisfactory knowledge of the basic principles of civil, mechanical and electrical engineering.

Before leaving the subject of day classes, the writer wishes to draw attention to the need of arranging for each student to make some contribution towards the teaching of his fellow students. It is extremely desirable that a student should have experience in speaking before and making his subject-matter clear to other students. Painful experience of listening to discussions at engineering institutions has impressed us with this desirability.

Most technical institutions have some form of engineering society, but comparatively few students have studied a particular subject sufficiently to give a lecture, and usually only the more prococious students can be persuaded to contribute papers to such a society.

An alternative scheme would be to give each student a separate subject for investigation and for the preparation of a lecture. In spite of some very strong points in its favour, the scheme has serious defects, such as:—

(a) Not more than one contribution per annum could be expected from each student.

(b) Would be difficult to find a number of equally suitable subjects.

(c) Would be a case of reading or of memorising the subject-matter.

(d) Would tend to upset the routine work of the course, especially amongst the slower students.

A scheme which the writer has adopted with a great deal of success during the last four years is to set aside an hour a week for what may be termed a discussion class. Each week, about three questions are given out for the following week's discussion, these questions being either directly or indirectly on work already covered by the lectures. When the hour for discussion arrives, any student is called upon to deal with a particular question and discuss it in front of the class. Such a scheme must, of course, be introduced very carefully in order that it may start off successfully with a high standard to be maintained on subsequent occasions. Not a single case of refusal on the part of a student has been experienced; but it is obviously essential that when a nervous student hesitates or loses the thread of his argument he should be assisted sympathetically. It is only by listening to such discussions that a teacher begins to realise how easily he may be misunderstood. It also affords an opportunity of putting pertinent questions to test the depth of a student's knowledge of the problem that he is endeavouring to elucidate. Incidentally, the student's treatment of various problems is extremely helpful in giving the teacher different viewpoints.

After a question has been dealt with by one of the students, the other students are invited to criticise the answer, and the first student has to deal as far as possible with such criticism.

Turning now to the question of evening classes, we find that the problem is much more difficult than in the case of the day classes. Most institutions have a five- or six-year course in mechanical engineering, but only in a few cases is electrical engineering introduced. This omission is undoubtedly a serious mistake for the reasons already discussed. It is again encouraging to find that at the Glasgow Royal Technical College, the mechanical-engineering course included 2¾ hours a week of electrical engineering in the third year and 1½ hours a week in the fifth year; whilst at the Heriot-Watt College, one evening a week of electrical engineering in included in the second-year mechanical engineering course.

It is, of course, impossible—nor is it desirable—for all technical colleges to adopt the same scheme; but it is maintained that one evening a week for two years should be the minimum time devoted to electrical technology during a five-year course in mechanical, civil and mining engineering. The two years should preferably be consecutive and not separated by a session as at Glasgow.

Tenders Accepted.—Tenders from the G.E. Co., Ltd., have been accepted by the Admiralty for 3,600 Nightsight and telephone lamps, and by the G.P.O. for 12,000 carbon filament telephone lamps and a further 3,000 metal filament telephone lamps.

We have received from the publicity dept. of the **British Thomson-Houston Co., Ltd.**, a set of specimens of the new publicity matter which is being prepared by the company for the coming lamp season. It represents an excellent assortment of at least sixteen items, including show cards, window signs, glass signs, folders, and window display attractions, as well as an exceedingly practical card of useful hints, which should be of value to every electrical installation contractor and supplies dealer who keeps a regular list of names and addresses of his customers, because they are certain to appreciate such a card as this when addressed to them in the ordinary way of business. We quite expect that the company's enterprise in this direction will help to increase very considerably the sale of Mazda lamps during the coming season.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of

CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N. 17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application, Subscription : 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

¶ *Readers are cordially requested to note that on September 5th "Electricity" will again appear in the familiar apple-green cover of pre-war days. See also special announcement on page 447.*

Current Topics.

Straws and the Wind.

To the observant there is much of interest in the many signs of change brought about by the conditions under which we exist to-day. For example, the recent pronouncement of a prominent M.P. in favour of pressed-steel construction for building houses and other urgently required accommodation for our teeming populations. If the bricklayer is obsolescent, why adopt the Micawber attitude and wait for something to turn up when new methods and entirely new principles of house construction are immediately available? Moreover, there is a very sound argument in favour of all-steel houses; they would give a much-needed fillip to our stagnating steel industry, whilst helping to solve the problem of housing, one of the most anomalous conditions in our home industry being a prolonged dispute in the very industry which should at the present time, and for years to come, have least reason to complain of a slump.

Again, coincident with widespread Press warnings of an imminent strike of electricians, we have an announcement of the opening of the first automatic electric sub-station installed in this country for railway operation. This is the new sub-station of the Underground Railway extension to Edgware, at Burnt Oak. Its outstanding novelty consists in the fact that the plant and control gear will be locked in the sub-station, and operated entirely without attendants from the central power station at Lot's Road. Only a short time ago a similar automatic sub-station for electric power supply was inaugurated in one of the districts served by the Liverpool Corporation Electricity Supply authorities at Lister Drive. The principle of automatic control from a point remote from the actual plant and switchgear is not new in the States, where it has been common practice for some time past. Its introduction into this country, however, is a sign of the times, and an indication that public utilities are finding ways and means to eliminate the undependable human element as far as practicable.

The modern and growing tendency of labour in connection with important public services, such as transport, power, lighting, building, etc., is to adopt the tactics of the opportunist, and literally hold a pistol at the heads of the long-suffering public on each and every occasion that there is the slightest chance of getting something out of him. In fact, it is no exaggeration to say that certain sections of organised labour to-day spend so much time making the most of their opportunities in the field of discord that they have literally no time left in which to perform the normal duties for which they are paid a weekly wage. In the circumstances, it is scarcely to be wondered at that man's ingenuity is devoting itself to devising ways and means for dispensing with as much of the troublesome human element as can reasonably be done without, and that despite the fact that unemployment is rife at the present time. The recurrent strike fever is bound to react upon itself in due course, and that it is already doing so is evident from the developments above outlined.

Tidal Power at Last.

It is announced that a contract has been let by the Weaver Tidal Power Syndicate, Ltd., to the Power Construction Company, Ltd., for the construction and installation of a hydro-electric power plant which is to be erected at West Mersea, Essex, and will be operated by utilising the rise and fall of the tides. The site has been selected on account of its natural facilities, and also because the towns in the neighbourhood, including Colchester and Southend, will ensure a large demand for the electrical energy generated. Work has already been started, the first portion of plant being displayed to generate over 4,000,000 units per annum. When the entire scheme has been completed it is estimated that over 15,000,000 units will be produced each year. This is the first practical attempt of its kind to utilise the tides for the continuous generation of electrical energy, and its development will be watched with interest by electrical engineers throughout the British Isles. Meanwhile, Colchester is disclaiming any intention of participating in the scheme from the standpoint of bulk consumption of any energy generated.

Volcanic Power?

Another project for harnessing natural power resources is reported in *Popular Science Monthly*, which states that engineers are preparing to harness the great volcano Tatio, between Chile and Bolivia. They plan to convert into electrical energy that developed by the boiling lakes of lava in Tatio's depths, and to utilise it for driving the mountain electric railways. A coal shortage was the direct cause of this project. A geological party, seeking oil along the Chilean-Bolivian boundary to supplant the dwindling coal supply, noticed a huge cloud that clung to the side of the volcano. They discovered that the phenomenon was caused by great clouds of steam puffing through the cracks in the mountain side. Engineers who had successfully used volcanic heat for power in Italy, were invited to inspect Tatio and estimate the volcano's possibilities as an energy producer. With suitable plant, they asserted, the steam emanating from Tatio's slopes could be converted into the electrical equivalent of half a million tons of coal per annum.

A Wise Precaution.

Now that we are being treated to a continuous succession of thunderstorms all over the country, presumably as a finale to a non-existent summer season, it behoves all devotees of broadcasting to take the simple precaution of "earthing" the aerial at all times that thunder or lightning prevail in the vicinity. It is such a very simple operation even in the absence of a suitable switch inserted in the aerial circuit, all that is necessary being to disconnect the aerial and earth respectively from the set, and connect them together by simply twisting the two ends of the wires so as to form a temporary and direct connection to earth. In these circumstances the aerial functions as a lightning conductor, and adds to the safety of the house during a thunderstorm, being, in fact, an efficient lightning conductor. It is preferable, wherever possible, to make the connection between aerial and earth wires outside the building, thus affording an external path for any lightning stroke.

An Electrical Carnival.

Coincident with the proposed visit of the Incorporated Municipal Electrical Association to Wembley Exhibition in September, it is proposed to hold an Electrical Carnival and Dance at the Exhibition, and a general committee is working out the details at the time of writing. The carnival will comprise a procession in which will be featured electrical apparatus or applications of electricity in tableaux and humorously constructed symbols. Suggestions are invited for original ideas and costumes to make the affair as great a success as possible. In the evening a gala dance is to be held at the Palace of Dancing, when exhibitors and their staffs, together with friends and customers, will make merry and compete for attractive prizes. Light refreshments will be provided, and tickets are on sale at the very moderate inclusive price of 6s. each. Applications, together with any suggestions for original displays, should be sent in without delay to Mr. Gibson Young, B.E.A.M.A., Avenue 15, Bay 8, Palace of Engineering, B.E.E., Wembley.

Electric Shocks.

Among other things, the war has brought to light additional information in regard to electric shocks. Dr. S. Jellinek, in a German scientific magazine, remarks that the shocks resulting from contact with the electrified wire fences used during the war (usually charged at a potential of 1,000 volts) varied much in severity. One more important factor was undoubtedly the "state of preparedness" of the victim. Experience has shown that a shock which was likely to prove fatal if received unexpectedly was harmless when anticipated. Experiments on animals have confirmed this impression, and have been instrumental in showing that physiological effects of shocks administered with direct and alternating current are distinctly different. It is also remarked that a close resemblance to death after shock should not be accepted too readily as proof. Persons apparently dead have not infrequently recovered when artificial respiration was applied. It is best to give the victim the benefit of the doubt. Unfortunately, the safeguard of a "state of preparedness" is seldom available in the ordinary everyday cases of accidental contact with live metal.

The Conference on Illuminating Engineering.

The conference arranged by the Illuminating Engineering Society at Wembley on August 12 drew a good audience and revealed a general recognition of the need for co-operation in illuminating engineering. After 18 years has elapsed since the starting of the movement, its founders rightly feel that the time is ripe for an energetic effort to induce the public to appreciate the value of better lighting, and we hope that the efforts of the society, endorsed by two special resolutions at the conference, will find worthy support. Mr. Gaster, whose address gave the keynote to the gathering, carried the meeting with him in his desire for a movement in which all sections of the lighting industry as well as the public can join. The unanimity with which joint action is approved, alike by gas and electrical engineers, shows that the pioneering work of the past has not been wasted, but has established confidence in the wisdom of the methods which the society has for so long pursued.

The Lighting of the Exhibition.

These methods were well illustrated in the discussion which took place later on the lighting at Wembley. Mr. Jennings and Mr. Harrison, respectively associated with the gas-lighted and electrically-lighted sections, in turn set out the aims and merits of their systems. It was unfortunate that Mr. Harrison's ill-health prevented his personal attendance. But the handicaps experienced in the electric lighting are well known. The original scheme was not carried out in its entirety. Hence, whilst in many respects the illumination is undoubtedly an advance over past efforts, there is a general feeling that at present it is hardly worthy of the occasion. It now seems probable that the Exhibition will be continued for at least another year, and, if so, I earnestly hope that the authorities will awake to a feeling of their responsibility in this matter. For a British Empire Exhibition, illustrating the varied applications of electricity, something out of the common is expected. Sufficient energy should be allotted to make the lighting of the grounds a source of wonder and attraction worthy of a country which may fairly claim to have given a lead to Europe in illuminating engineering.

ELEKTRON.

A folder illustrating and describing the "Easy-to-Read" Dial Thermometer has just been issued by the **Cambridge Instrument Co., Ltd.**, of 45, Grosvenor Place, London, S.W.1, and will be willingly sent to any reader on application.

TELEGRAPHY.*

Being solutions to the questions set at the Grade I. examination in Telegraphy held by the City and Guilds of London Institute, on April 30, 1924.

(*Continued from page 444.*)

Q.—What are the relations between the length of span, the dip or sag of the wire, and the stress on the supports in overhead line construction? What materials are used for conductors, insulators, and supports?

A.—The curve assumed by any flexible inextensible wire when freely suspended from two supports is known as the *catenary*; but for the comparatively short flat spans in vogue in this country, the curve may be assumed to be parabolic in form without appreciable error. The required relations are—

$$s = \frac{l^2 w}{8d}$$

and

$$d = \frac{l^2 w}{8s}$$

where s is the stress in lbs.

l ,, ,, length of the span in feet.

w ,, ,, weight in lbs. per foot of the wire.

d ,, ,, sag or dip of the wire in feet.

Example.—What is the stress on a 200 lb. copper wire if the sag is $2\frac{1}{2}$ feet in an 80 yard span?

$$s = \frac{l^2 w}{8d} = \frac{(80 \times 3)^2 \times \dfrac{200}{1760 \times 3}}{8 \times 2\frac{1}{2}}$$

$$= 109 \text{ lbs. approximately.}$$

suThe materials used for conductors, insulators and pports are :—

Conductors: copper, bronze and iron wire.

Insulators: porcelain and brown earthenware.

Supports: poles are of red fir or American pitch-pine. Iron poles are also extensively used. Arms are of oak or Australian karri-wood. Iron arms fitted with strips of wood on the upper side are also used.

(*To be continued.*)

ELECTRICAL ENGINEERING.—FINAL GRADE.

Solutions to Questions set at the 1924 Examination of City and Guilds Institute.

BY EDWARD HUGHES, B.Sc., A.M.I.E.E.

Q. 1.—Two alternators of different kilovolt-ampere capacity are required to work in parallel and to share the load in proportion to their ratings. How must the governors of the prime-movers be set to ensure this? Explain fully how each of the machines can be adjusted so that its power factor is the same as that of the external load.

A. 1.—In order that two alternators operating in parallel may share the load in proportion to their ratings, two requirements must be fulfilled :—

(*a*) The percentage drop in speed of the prime-movers between no load and full load must be equal.

(*b*) The percentage drop in terminal voltage between no load and full load (i.e., the voltage regulation) must be the same for the two alternators.

The first requirement is for the purpose of ensuring that the power components of the currents may be in proportion to their ratings, and is met by setting the two governors for the same percentage speed variation between no load and full load. Compliance with the second requirement ensures that the wattless components of the current are proportional to the ratings.

It is usual to install a power-factor meter for each alternator. If these meters are not reading the same, one alternator is working at a higher power factor than that of the load, whilst the other machine has a correspondingly lower power factor. The power factors can be made equal by varying the excitations of the two alternators; thus the field current of the first alternator is increased whilst that of the other is reduced, the bus-bar voltage being kept constant. The adjustments are continued until the the power-factor meters read alike, signifying that the power factor of each machine is the same as that of the external load.

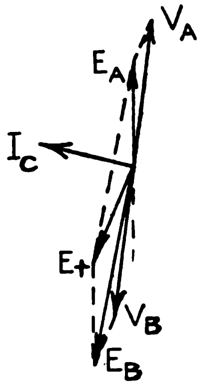


FIG. 1

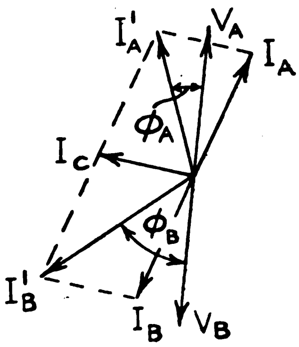


FIG. 2.

The reason for this may be more easily followed if we start with two alternators A and B operating at equal power factors and having equal e.m.fs in exact phase opposition relatively to each other. If the excitation of B be increased, the very slight increase of load causes its e.m.f. to fall back relatively to E_A by a very small angle as shows in Fig. 1. The resultant voltage due to E_A and E_B is represented by E_r; and the latter may be regarded as setting up a current I_C circulating round the two machines and lagging nearly 90° behind E_r, owing to the reactance of the windings being large compared with their resistance. The vectors V_A and V_B representing the terminal voltages of A and B respectively are equal and opposite and are parallel to the diagonal $E_A\ E_B$ (not drawn).

To avoid confusion due to a large number of vectors, Fig. 2 has been drawn with V_A, V_B and I_C as derived in Fig. 1. Suppose I_A and I_B to be the original currents supplied by A and B respectively previous to the excitation of B being increased. Then the resultant current supplied by A is represented by I_A^1 the resultant of I_A and I_C; whilst the resultant current from B is similarly represented by I_B^1. Also, it will be seen that the power factor of B, namely cos ϕ_B, has been reduced; and that of A, namely cos ϕ_A, has been improved and may even be leading. Hence it follows that when two alternators A and B are operating in parallel with the power factor of A better than that of B, the excitation of the former must be increased and that of the latter reduced in order that the power factors may be equalised.

---

* Books recommended are:—*Questions and Solutions in Telegraphy and Telephony, Grade I.*, by Few (Rentell, 5s. 10d., post free), and *The Telegraphists' Guide*, by Bell and Wilson (Rentell, 3s. 10d., post free).

(*To be continued.*)

THE ELECTRICAL KITCHEN FOR PRIVATE HOUSES.*

By Prof. H. Bohle, M.I.E.E.

(*Continued from page* 445.)

Discussion (*Abstract*).

Mr. A. E. Val Davies: On the point of hay cookers—fireless cookers, wherein food is allowed to simmer for hours at a time—food experts now are quite definite in asserting that the elusive undefined vitamines that go to make food valuable are destroyed in these slow cooking processes. They do not know much about the vitamines, but they know this, that the less food is cooked the better it is. I believe that experiments which have been going on for the last four or five years show that there is something wrong with present-day methods of cooking. The investigations are certainly clear on the point that fireless cookers destroy some of the value of food, quite apart from its value as a fuel.

I also question the statement that to get economy in connection with hot-plates the bottoms of both the hot-plate and the vessel heated should be polished. Now, if one could have an intimate mathematical contact—a true contact—between the heated and the heating surfaces, that statement is quite correct; but since it is quite out of the question—experiments have shown that the rougher the surfaces are the better—it is a question of what proportion of heat is conveyed by conduction as against radiation, and it is now a proven fact that the rougher the bottoms are of both hot-plate and heated vessel, the more efficient is the utensil. By "roughness" one does not mean irregularity.

Professor Bohle mentions the somewhat unexpected efficiency of an enlarged hot-water heater. This is largely due to the fact that in a confined room, like a bathroom, the vessel, in getting rid of its heat, must raise the temperature of the surrounding atmosphere, and thus the heat lost by radiation diminishes and the efficiency goes up.

Professor Buchanan: In quite recent times criticism was common regarding the electric furnace, compared with the open hearth steel-melting furnace; but, in spite of the apparent low fuel cost of the latter, the number of electric furnaces in use has rapidly increased, owing to the many inherent advantages of electric heating. In many towns the use of electric cookers is retarded by the relatively high price charged for electricity, when compared with the cost of coal or other fuel. In Capetown, with house coal costing about 50s. a ton, it should not be difficult to show that cooking and heating by electricity at one penny a unit is a sound proposition; but in Johannesburg, with coal £1 a ton and electricity 1½ pence, only after using six units per room at 6.6 pence per unit, the money benefit is doubtful.

Supply engineers may, in some cases, have to change their distribution from D.C. to A.C. when the heavy load expected can readily be met by increasing the number of transforming points. I am glad Prof. Bohle has given us this interesting paper. He has made a scientific study of the subject and raised it out of the rut of mere commercialism, and when members have had the opportunity of studying his experiments, an instructive discussion is sure to take place.

Mr. J. B. Bullock: I would like to congratulate Professor Bohle on his total monthly consumption, which appears to average 117 units. I, like Mr. Val Davies, was an enthusiast on electric cooking, so long as I did not pay for the units used. I made my own apparatus, such as an oven, hot plate and bath-water heater, and the convenience of the "electrical way" was very much appreciated by the user; but, when I came to Johannesburg and found that I averaged on lighting alone about 80 units per month in a four-roomed house, it became quite a different story, and I think 117 units must argue most watchful economy and represent a result which could not be generally attained. I cannot believe that this figure includes any electrically heated baths.

At the same time, the author makes out a very encouraging case, and I have no doubt that, at Johannesburg municipal rates, there is a very wide scope for electric cooking here. The pity is that, owing to the welter of politics in which electricity supply is involved in this municipality, the engineers concerned are compelled to approach the question as one hedged about by all sorts of extraneous restrictions and limitations. Until we are able by some merciful dispensation of providence, or the electors, to remove these, "other uses" of electricity must stagnate, for the lead must come from the supply authority.

At present one might truly say that the political tail is wagging the engineering dog.

As the question of electrically heated bath water at public baths in Poplar has been successfully tackled by Mr. J. H. Bowden, who has shown an economy therewith as compared to gas, in face of a price cut by the gas undertaking, his calculations are worthy of earnest consideration.

The ideal set us seems to be a supply network so arranged and controlled that any load demand at a higher rate per unit coming upon it will automatically shake off an equivalent load at the lowest rate, such load naturally being a heat storage or water heating one. This may to-day seem somewhat Utopian, but I feel that such a position will develop, and probably quite soon. One is considerably encouraged in this expectation by the rapid development of the automatic sub-station.

Cooking in this country is, as a rule, a matter of discomfort, and one of the strongest recommendations of the electric way is comfort and convenience.

In view of the remarkably economical results obtained by the author with his round type of slow-cooking oven, it is a matter of disappointment to learn that, by its use, the vitamines of the food are destroyed. Further, I am not sure that the housewife will appreciate having to set about preparing food to cook for luncheon somewhere about eight in the morning in order to start the slow-cooker by nine o'clock.

These considerations rather discount the prospects of electrical slow cooking, and I consider that, from the domestic point of view, it will always be a recommendation for the electric way that cooking can be done quickly and to an exact and unvarying time schedule.

---

* Abstract of paper read before the S.A. Inst. of Electrical Engineers.

I do not consider that load density and the resulting necessity for excessively heavy mains should be allowed to be a stumbling block, as experience has shown that domestic loads have a high diversity factor, and in any case, if one can sell the units, one can afford to provide the necessary copper.

I have not had the opportunity of studying Professor Bohle's water-heating system, but I gather that he proposes to heat comparatively large volumes slowly. This is undoubtedly the correct method to adopt, and a useful adjunct would be a geyser for "superheating" small quantities of water which have already been raised to about 90 deg. F. The loading of such a geyser would not need to be as high as if it were dealing with water initially cold, and it need scarcely be emphasised that such an apparatus, if widely used, would present an extremely high diversity factor.

Mr. Galpin: Professor Bohle seems to be an aluminium-pot enthusiast. Exactly why I do not know. Because, I think, the average housewife will tell you that the aluminium pot is the curse of the home; it is a most troublesome thing to keep clean, easily dents, and the bottom warps, and its many disadvantages, apart from other considerations, have greatly reduced its popularity. In addition to this, I have available the results of some actual tests performed in America, not under laboratory conditions, with perfect vessels, polished on the contact surfaces, and so on, but under ordinary household conditions such as are likely to prevail in the average home, and there it is conclusively shown that the enamelware pot is far superior to aluminium for electric cooking. Admittedly the aluminium pot lets the heat through the bottom much quicker than the ordinary pot; unfortunately, however, it also lets the heat out at the sides more easily, and the balance is found to be in favour of the enamelled iron pot.

A NEW WIRELESS VALVE.

While, as was to be expected in a new industry, we are frequently being introduced to new features and novel methods of construction in the details connected with the apparatus concerned, there are some few which are of especial interest, and from their simplicity, as well as the logical correctness of their claims, appear to be more worthy of notice than others. Among these we consider the valve now offered by Messrs. G.W.I., Ltd., as a "plateless" valve, is one which should interest our "wireless" readers as a detail offering some notable advantages over the ordinary type. As its name implies, it has no separate metal plate in relation to the grid for dealing with the H.T. signals received from the aerial. In the ordinary valve this plate is recognised in varied shape, but usually as a cylinder supported by fine wire stems which cannot but be in some measure susceptible to vibration, which, when it occurs, inevitably produces distortion in the sounds transmitted. In the new valve this plate is entirely eliminated, and its function is performed by a metallic silver coating on the interior wall of the glass bulb, which is made of a tubular shape, and in relation to which the grid—of a much larger area and a much more robust construction than the usual curl of wire—presents a surface for conduction to the anode which must tend to increase signal reception and efficiency. The reduction or practical elimination of vibration also ensures great purity of tone. The claim is that the tone obtained with this valve is fully equal to the crystal in purity.

We have had the opportunity of testing the operation of one of these valves, both with an external and indoors aerial, and are able to confirm to a very large extent the advantages of the features claimed by the makers. As an H.F. amplifier on the outdoor aerial in combination with a "Cossor" detector the reception was exceedingly fine and sharp from distant stations within range, while on the indoors aerial, and the lamp as single detector only, the result was quite equal to the crystal in purity on short range, and much stronger in tone. A filament voltage of 3.8 with 45 volts H.T. was found ample here, with rather higher in both cases when using as H.F. amplifier. It is possible and probable that with the same type of valve as detector, in combination with the amplifier, the result would be still better. The valve, although not claimed as an L.F. amplifier, was tested as such in combination with a crystal, and gave very fair increase of tone without affecting purity. The makers are Messrs. G.W.I., Ltd., Grafton Street, W.C.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 186.

When viewing a cinematograph picture, the wheels of a carriage appeared to be turning backwards. Can any reader explain this to me?—"INQUISITIVE."

QUESTION NO. 187.

I wish to use a 100 volt., 3 amp. D.C. motor on 210 volts. Can any reader tell me how to construct a resistance to enable this to be done, since I am told that this is the most economical way of doing it?—"H. W. MAY."

(Replies to Questions Nos. 186 and 187 must be received not later than August 30, 1924.)

List No. 317, dealing with steel filing equipment, has been issued by **Messrs. G. A. Harvey**, of Suffolk House, Lawrence Pountney Hill, London, E.C.4, and should prove of interest to business men and office managers generally.

Quotations Wanted.—A new scheme is being undertaken by the Czechoslovak Government for the electrification of the State railways, and tenders are being invited for locomotives and materials in connection with the project, which has been published by the Czechoslovak Ministry of Railways. Specifications, etc., from the D.O.T. (Room 52), 35, Old Queen St., London, S.W.1.

THE "RAILODOKS" AND LAUNCHES AT WEMBLEY.

(*Concluded from page* 438.)

Another installation which will interest many of our readers is that which was fitted up by Messrs. Drake and Gorham for the purpose of charging the electric launches on the lake.

Each launch, of which there are 30 altogether, is propelled by an 80-volt motor, the electrical energy being derived from a battery of accumulators housed under the seats. Each battery consists of 42 cells, and thus a supply of energy at 110 volts is necessary for charging purposes. As with the "Railodoks," the D.C. supply available consists of a 3-wire system 440 volts between outers, and it was, therefore, decided to charge the batteries four in series, balancers being provided to take care of out of balance current due either to a variation of the current required by individual batteries, or to an odd of batteries being on charge simultaneously.

The charging plant, Fig. 6, is accommodated in a kiosk about 16 feet long and 15 feet wide, inside measurement, specially built for the purpose, and situated at the N.E. corner of the lake. It consists of two 3-wire balancers, each comprising two shunt-wound machines direct coupled on cast-iron bedplates, and each capable of dealing with an out of balance current of 50 amperes.

For the incoming supply and control of the balancers the following switchgear is installed, viz. :—One main in-coming panel, having mounted upon it a 300 amp. D.P. circuit breaker, fitted with overload and reverse current trip, together with ammeters and voltmeters for reading the current in each outer and the voltage between each outer and neutral, and two balancer panels, each with one 50 amp, S.P. circuit breaker with overload and reverse current trips, two voltmeters each reading to 150 volts, one central zero ammeter and starting rheostat for balancer.

The charging panels are 30 in number, built up into one switchboard which extends the whole length of the south side of the kiosk. Each panel carries:—1 D.P. 50 amp, Q.B. knife switch, 2 50 amp. S.P. Home Office type fuses, 1 regulating switch and charging resistance, 1 indicating lamp and socket, 1 ammeter 50 amps., 1 voltmeter 120 volts.

The whole of the switchgear consists of slate panels, mounted on angle iron framework, and arranged sufficiently far from the walls to allow of easy access to the back of the various boards. The cables between the various boards and the machines are all placed in trenches which were constructed in the floors adjacent to the walls and covered with plates. From the charging panels 30 separate sets of charging leads are taken in a trench along the side of the lake to mooring posts, C.I. pipes being used instead of the trench under two other kiosks. These mooring posts are constructed of standard W.I. pipe fittings and are equipped with a ring at the top for the boat's painter and a charging plug at the side, the cable to the plug running up the centre of the post. From these plugs a cab tyre twin flexible cable is taken to the charging terminals on each boat. Thus as soon as a boat is moored in its correct position and the flexible lead plugged into the post, the corresponding lamp in the charging station lights up and the attendant can switch on and begin charging, regulating the current as required in accordance with the readings of the instrument on each panel.

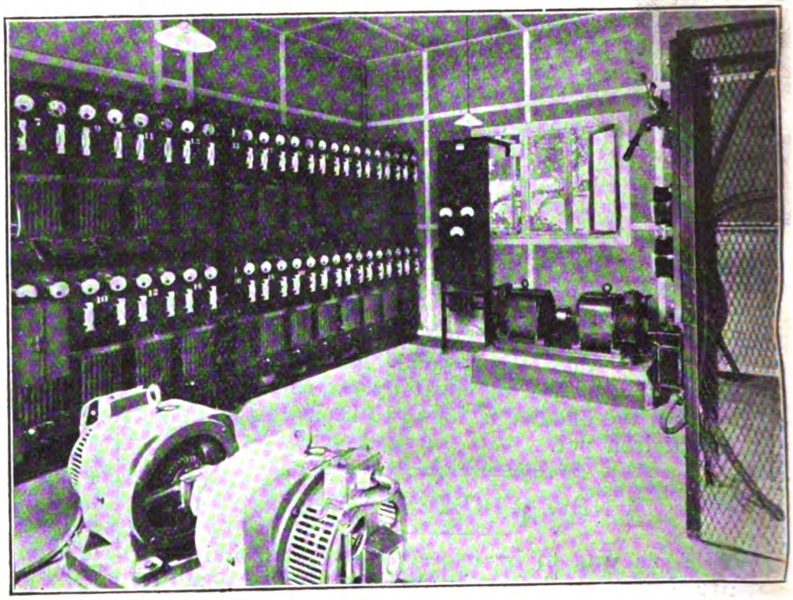


FIG. 6.—ELECTRIC LAUNCH CHARGING PLANT, SHOWING 3-WIRE BALANCERS, CHARGING PANELS, ETC.

Various Items.

Removal.—Owing to increase of business, John Thompson Water Tube Boilers, Ltd., of Wolverhampton, have found it necessary to remove their head office to Imperial House, Kingsway, London, W.C.2. Telephone number, Regent 3216.

Tenders Accepted.—The municipal authorities of Derby have accepted the tender of Vickers and Internal Combustion Engineering, Ltd., for a complete pulverised fuel installation for the Corporation power station.——The L.M. and S.R. Co. have accepted the tender of the G.E. Co. for the supply of 5,000 special train-lighting lamps.

Military Charities.—We are pleased to hear from the headquarters at Aldershot that the result of the Aldershot Command Searchlight Tattoo, which was held a few weeks back, have come up to the sanguine expectations of the promoters, the gross receipts amounting to more than £10,000.

The Illumination of Pleasure Steamers.—"Brightness on board" is apparently the motto of Messrs. P. and A. Campbell, Ltd., who own a fleet of steamers which ply between Brighton, Sandown, Worthing, Ryde (Isle of Wight) and Boulogne. Of these, one, the P.S. *Devonia*, is fitted throughout with Osram 100 volt 30 watt ship type lamps. The illumination obtained is excellent, and one can pass along, and across, the decks at all times with ease and comfort, and without risk of fouling the lockers and rope ends which are inseparable from life on board.

ARMATURE REPAIRS
MARRYAT & PLACE.
28, HATTON GARDEN,
LONDON, E.C.1.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

SEPTEMBER 5, 1924.

CONTENTS. PAGE

A New Model A.J.S. Wireless Receiver 461
The Lamp Publicity Campaign 462
Short Wave Directional Wireless Telegraphy 464
The "Winged Clocks of Wembley" 465
The Transfer of Super Electrical Plant 466
Current Topics 469
The G.E.C. at the All-British Wireless Exhibition 470
Practical Electrical Engineering Hints 471
Electrical Installation Work 472
Telegraphy 472
Electrical Engineering—Final Grade 475
Questions and Answers by Practical Men 476
Wembley Electrical Carnival and Dance 477
Various Items 478

A NEW MODEL A.J.S. WIRELESS RECEIVER.

A new model wireless receiver is now being placed on the market by the Wireless Branch of Messrs. A. J. Stevens and Co. (1914), Ltd., Wolverhampton, and may be seen at their stand, Avenue 14, Bays 9-10, in the Palace of Engineering at Wembley.

As will be seen from the illustration of the four-valve receiver, these instruments are of handsome appearance, and the three- and four-valve types have each a valve switch, enabling the four-valve instrument to be used as a four-, three- or two-valve receiver, and the three-valve as a three- or two-valve outfit, without loading coils, over a wave band of 150-500 metres, but plugs and sockets are provided to permit of loading coils being fitted to operate on other wave-lengths.

The New Model A.J.S. Four-Valve Receiver.

Another desirable adjunct which can only be used with an A.J.S. receiver is the firm's patented rejecter circuit for cutting out dominating stations. A further noteworthy point is that fixed resistances of about 20 ohms are fitted to each valve behind the panel. These resistances are for use with 3-volt .06 amp. valves; for use with other types of valves plug-in shunt resistances are provided. By this means it is ensured that the valves work on their point of maximum efficiency and accumulators are properly cared for through not being allowed to run dry.

In the new model the special method of stabilising the first H.F. valve ensures that the inductances are undamped, and its efficiency is thereby greatly increased in regard to strength of signals, selectivity and the power to "pick-up" and amplify very weak signals. This power of assimilating weak signals enables it to be used on frame aerials, and also on small indoor aerials, and as there is only about 10 degrees difference on the aerial tuning dial between no aerial at all and a large aerial, it follows that what may be termed constant aerial tuning forms a salient feature. This allows of not only any one station being tuned in on practically the same place on all types of aerial, but also prevents the swaying of the aerial—a common and obscure cause of "fading"—from affecting the signal strength of the receiver.

The capacity of the new type instrument is also such as to give full efficiency on all wave-lengths between 150 metres and 20,000 metres. Up to 550 metres single layer inductances wound with large gauge wire are used, with no "dead-end" on wave-lengths of 250 metres to 550 metres. Above these wave-lengths plug-in coils, again with no "dead-end," are used. Further, while the new model receiver gives full reactance on all wave-lengths, the second valve only oscillates on, and below, broadcast wave-lengths, a feature which greatly tends to prevent interference when oscillating. This special method of low-frequency inter-valve coupling almost completely eliminates all undesirable outside influences such as atmospherics, spark stations, interference from electric light mains, etc., and thus greatly enhances the quality of the music and speech received. A further interesting feature is that the grid bias is to a large extent supplied or regulated automatically.

As in the earlier model, the A.J.S. patent variable condenser used in the new type instruments is fitted with anti-capacity shields, the vanes being also so shaped as to give a negligible capacity and a greater maximum than can be obtained with other types. The peculiar configuration of the vanes has the effect of making the instrument less difficult to operate. These condensers have no rubbing contact, are fitted with ebonite end-plates and have brass bushes $^9/_{16}$ in. in length by $\frac{3}{8}$ in. in diameter, the aluminium vanes being 22 gauge with .08 in. spacers. The capacities are .0003 and .0005, and they are of the highest grade as regards material, workmanship and finish throughout.

A novel feature incorporated in the four-valve set enables the third or fourth valve to be used as a power-amplifier when switched on to the loud-speaker, so that when three valves are used the third valve acts as a power-amplifier, and when four are in use the fourth valve acts as such.

The high-tension volt meter shown fitted in the panel gives at a glance an indication of the state of th batteries.

MAXIMS.

An optimist is one who, while shovelling snow, is happy because he doesn't have to mow the lawn.

A pessimist is merely one who has seen too much truth.

The man who coined the expression "Glorious war" never fought in one.

THE LAMP PUBLICITY CAMPAIGN.

As the years roll on readers of this paper become more and more familiar with the developments which are taking place in connection with the sale of incandescent lamps, and, as a natural consequence, they show an ever-increasing interest in the plans issued in the early autumn by the leading makers, in which they outline the arrangements they have made to assist retailers and the trade generally in setting forth the advantages of each particular brand of lamp, and thereby obtaining the best possible sale. Our friends, **The British Thomson-Houston Co.,** of "Mazda" fame, start off with the slogan "Publicity that helps the retailer," and say that all advertising by the manufacturer is, or should be, of benefit to the wholesaler and retailer, and it is difficult—and, indeed, unnecessary—to attempt to prove that any particular kind or method of publicity is better than any other. There is, however, no doubt that re-sellers themselves prefer the kind of advertising of which they can take direct and individual advantage. Newspaper advertising aims primarily at increasing the general demand, while, of course, incidentally increasing the business of individual retailers. Under present conditions, however, it is not always easy for the retailer to associate himself closely with this advertising, although he naturally recognises its value.

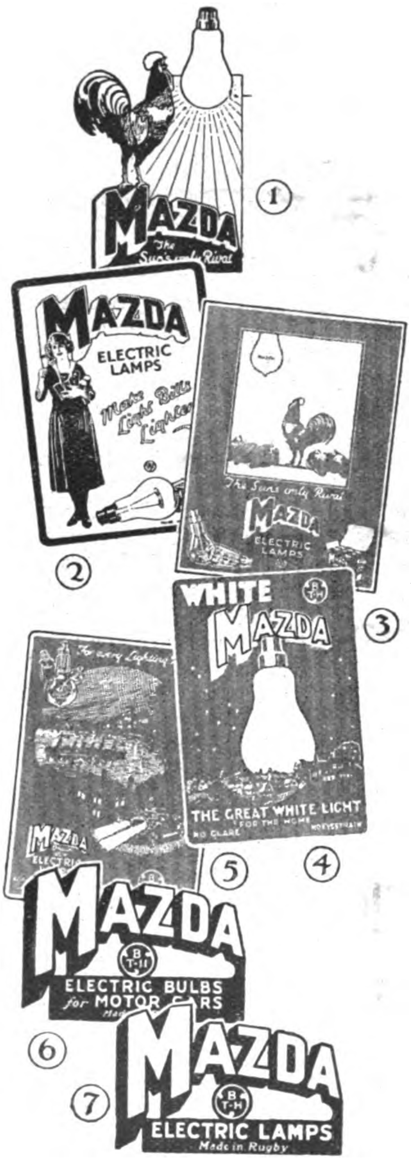


Fig. 1.—Cut-out, with Steel Point for Attaching to Woodwork.

Figs. 2, 3, 4 and 5.—Four Mounted Showcards with Cords.

Figs. 6 and 7.—Gold and Black Window Stickers.

On the other hand, in the case of the kind of advertising that works through the retailer, such as the distribution of showcards, leaflets, etc., he can, by taking thought and trouble, get more out of such publicity that other retailers who either do not receive or do not display or distribute the material.

For these reasons the present tendency in lamp advertising is, while not neglecting the Press, to give more and more attention to what are described in America as "dealer helps." Mazda dealers have not, in the past, complained of any lack of advertising material, but this year they are certainly being offered a greater variety of publicity items than in previous years.

On August 11, a circular containing illustrations in colour of the various Mazda leaflets and showcards available was sent to electrical retailers throughout the country, together with an invitation to requisition anything that they wanted. This leaflet illustrated and described ten different items of display material, *i.e.*, showcards, cut-outs, window signs, etc., and five leaflets, and to these we made reference on page 450 of last week's issue. Some of these illustrations are reproduced in black and white in this article.

There are, for example, four mounted showcards of standard size (Figs. 2, 3, 4 and 5), three of them dealing with regular vacuum and gasfilled lamps and the fourth with the white Mazda lamp. These cards are varnished, and each is equipped with a cord for hanging. Another attractive item is a small cut-out (Fig. 1) featuring a cock crowing at a Mazda lamp, and bearing the slogan: "The Sun's Only Rival." This cut-out is fitted with a steel point for attaching to woodwork. This is a very convenient form of showcard, because it can be fixed instantly to any shelf, counter or wood partition. When fixed, it projects at an angle of 90 degrees. One very attractive way of using the pin cut-out is to fasten it to the wooden beading in the inside of the window. Then there is the Mazda revolving shade, which is now well known to re-sellers, and was illustrated in these pages some years ago. If has been a constant feature of Mazda advertising for several years, and has remained unfailingly popular.

For those retailers who wish to attach advertisements to their windows, there are available two adhesive window signs (Figs. 6 and 7), one for regular lamps and the other for automobile lamps. These signs are printed in gold and black, and can be fixed in a moment by pressing to the slightly dampened window; while, for those who desire a more permanent window advertisement, there is an oval glass sign (Fig. 8) with silver and black letters. These signs are cemented to

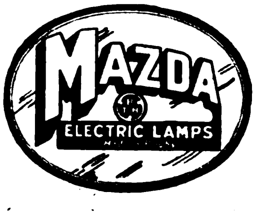


Fig. 8.—Glass Window Signs Fixed by Agents.

The MAZDA VADE MECUM
SOME USEFUL HINTS TO LIGHT USERS
The Vacuum MAZDA
The Gasfilled MAZDA
The White MAZDA

Fig 9.—The Mazda "Vade Mecum."

the windows by fixing agents. There is also an ambitious and well-arranged 36-page catalogue covering all types and sizes of Mazda lamps. Colour-sprayed, daylight and white Mazda types are all illustrated on the centre opening, and, as each of the seven available tints of sprayed lamps is illustrated, it will be appreciated that this centre spread represents a feast of colour rarely met with in such publications. Re-sellers will find this of very great value as a means of demonstrating to customers the wide variety of types and sizes in which Mazda lamps are now made. Other items include four leaflets (viz., one quarto and three of the standard envelope size) which can be overprinted, and deal respectively with (1 and 2) all types of vacuum and gasfilled lamps, including colour-sprayed, daylight and white Mazdas, (3) with white Mazda lamps, and (4) with Mazda automobile lamps. Yet another circular, which was, we understand, issued broadcast on September 1, is in the form of a mailing card, entitled "The Mazda Vade Mecum" (Fig. 9), and on one side bears a great deal of information useful to the average electric light user. For example, it tells him, *inter alia*, how to read his meter, and how to calculate the cost of using any particular lamp or electrical device. This card does not bear the name or address of the British Thomson-Houston Company, and the recipient is referred to the retailer for electric lamps, and also, by-the-bye, for repairs, etc. This vade mecum will undoubtedly be kept by most people, and, when it is considered that it will be read by at least 560,000 users of electric lamps, its advertising value is almost incalculable.

Finally, there is the Mazda poster, for which prominent positions have been taken throughout the country. It bears a plain lettered design in orange and white on a black background, and the appearance is unusual and distinctive. It is, therefore, expected that it will have a stimulating effect upon the sales of Mazda lamps.

We now come to the arrangements which are being undertaken by the well-known

Siemens and English Electric Lamp Co., Ltd.,

whose headquarters are in Upper Thames Street, and branches in all the leading commercial centres of the kingdom.

Naturally they also are anxious to assist the trade to the fullest possible extent, and have therefore embarked upon a most extensive and varied advertising campaign in connection with their renowned Siemens lamps. Their advertisements, which are of distinctive design, will appear in the foremost electrical trade journals, daily and evening newspapers, as well as high-class monthly and weekly magazines. A complete series of live advertisements will also appear in a large number of trade journals other than electrical, appealing to large users in other trades to purchase Siemens lamps from their usual suppliers; and, in addition to the above Press campaign, they will be exhibiting 16-sheet posters of a most striking design ("The Beefeater," Fig. 1) which will appear in prominent positions on hoardings in all large towns in the United Kingdom. The Siemens showcard ("The Crystal Gazer"), which is of attractive design in 10 colours, is being mailed to all re-sellers, while electric signs of various striking designs for window display possess pleasing and interesting features, especially when illuminated after dusk. These signs will be sent out on loan during the lighting season, and early application is desirable in view of the heavy demand for them. "The Crystal Gazer" design will also appear in all the trains on the London Underground railways, as well as double-crown posters on the platform approaches of the most important stations. In conjunction with their railway advertising scheme, the Siemens Lamp Co. have numerous designs in life-size oil paintings in actual colours, which will be exhibited on the indicator boards of the main termini both in London and the provinces.

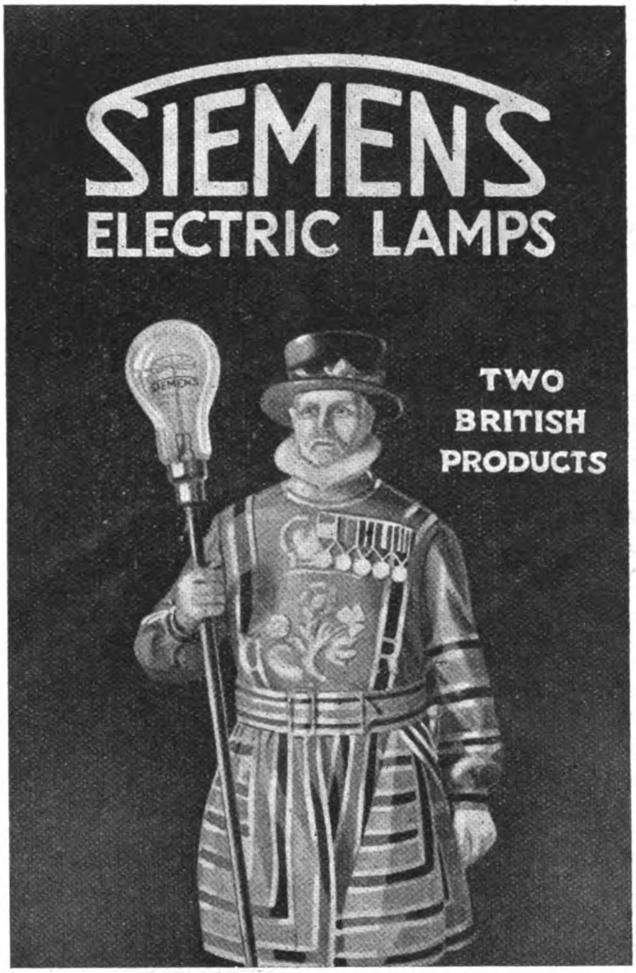


FIG. 1.

An attractive art blotter bearing a small reproduction of the showcard in colours, and printed with a useful calendar of the lighting months, is being mailed to hundreds of thousands of consumers throughout the country, and recipients are directed to their local dealers for their supplies of Siemens lamps; while the roulette game, to which we have already referred in our colunms, has made a quick appeal to all classes, and by the very wide reception it has received its success has been fully assured.

In addition, the company have a new Siemens game of "Wizard-Electric." This novelty will afford endless pleasure to many thousands of the younger generation, to say nothing of the elders, who will also enjoy the fun, and we hope to give full details in an early issue. Its story is complete, and the demand is such that early application by the trade is both desirable and necessary. Similarity we can recommend all retailers to put in a prompt request for a supply of the new price lists as their requirements are well met with a vacuum and gasfilled lamp leaflet No. 125, automobile and battery lamp leaflet No. 126, and white and colour-sprayed lamp folder No. 127 (Fig. 2). All have distinctive colour designs and space is provided for overprinting the dealer's name and address. Thousands have already been overprinted, and supplies will be sent on application to re-sellers who have not already received them.

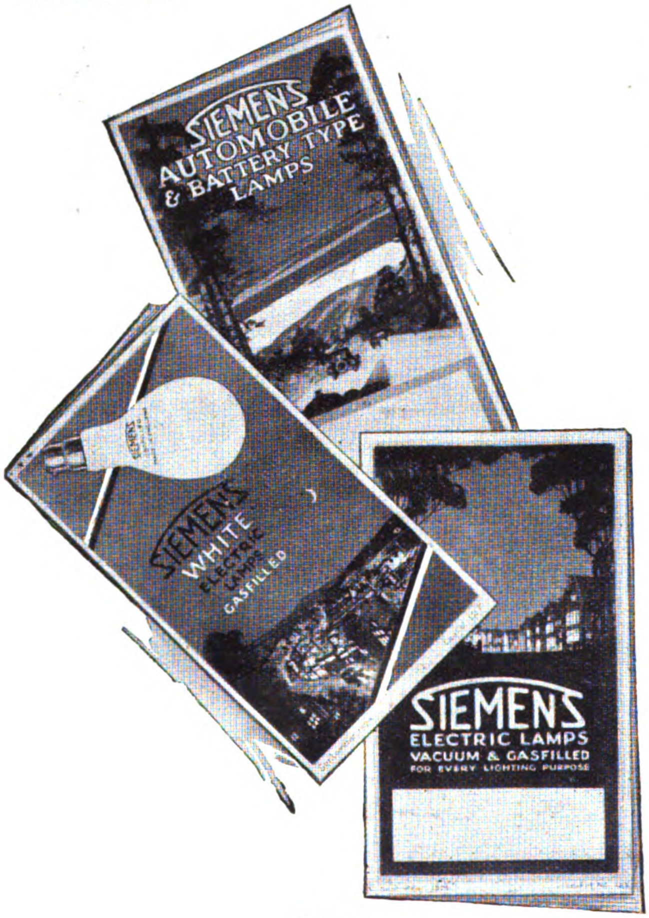


FIG. 2.

The trade is certain to appreciate the extensiveness of the Siemens campaign, as it appeals to all classes of consumers throughout the country, and should, therefore, help to bring an enormous demand for Siemens lamps.

It is impossible, of course, to convey any idea of the brilliant colouring and display value of the various showcards, catalogues, signs, etc., illustrated in this article, but it is nevertheless apparent that any retailer who cares to send for a fair proportion of the material described will have at his disposal all that he needs for an effective display, which should help his sales very materially.

SHORT WAVE DIRECTIONAL WIRELESS TELEGRAPHY.

A paper was recently read before the Royal Society of Arts by Senatore Guglielmo Marconi, G.C.V.O., LL.D., D.Sc., on the "results obtained over very long distances by short wave directional wireless telegraphy, more generally referred to as the beam system." Messrs. Marconi's Wireless Telegraph Co. have reprinted this paper from the journal of the society, and we understand copies are available for those interested who care to make application to the company.

It opens with historical references to the original experiments which showed that wireless waves could be propagated, reflected, refracted and defracted in the same way as waves of light. Many of these properties appear to have been sadly neglected, so far as development is concerned, and Mr. Marconi has certainly turned his attention with some effect to these undeveloped but known properties of the electric wave. The results are surprising, and Mr. Marconi and his co-operator, Mr. C. S. Franklin, are to be congratulated on their development of these comparatively new lines of research. The Beam system of signalling possesses many advantages. It can be highly directive, and may therefore be of considerable use in time of war; it also increases the number of stations it will be possible to work without mutual interference.

The power required for signalling is small when compared with that used on many of our long wave commercial stations, and this point is emphasised by referring to the author's statement that the value of the energy received when reflectors were used was two hundred times that of the energy that could be received without reflectors. In addition to the question of Beam signalling, there is much interesting information on experiments, conducted on the short wave lengths. This modifies to some extent our theories regarding electric waves, certainly short electric waves, in so much as it is now proved that day ranges may be reliable and not inconsiderable, night ranges were greater than anticipated, and intervening land and large portions of continent do not present any serious obstacle to the propagation of these waves.

The experiments were so encouraging that Mr. Marconi was tempted to try a wireless telephony test to Australia. Experimental arrangements were made at Poldhu, and on Friday, May 30, of this year, the first intelligible speech was transmitted from England to Sydney, and this date certainly marks a period in the advance of wireless telephony. This test was conducted on a wave length of 92 metres, valve transmitters were used, and the total power supplied was only 28 kilowatts. No reflector was employed, so that when we consider this in view of the possible saving in energy obtained by the Beam method, it should be possible in the near future to carry out commercial telephone service between England and Australia for a very low energy input. Commercial transmitters have been developed along the most successful lines, and no difficulty is presented in building transmitters of this type up to about 50 kilowatts.

A little learning is a dangerous thing, but the lack of it is often fatal.

THE "WINGED CLOCKS OF WEMBLEY."

Among the many public services which contribute to the success of the B.E.E. at Wembley and the convenience of visitors, mention must be made of the electric impulse clocks operating on the "Pul-syn-etic" system, and installed by the makers, Messrs. Gent and Co., Ltd., Leicester.

These clocks are fixed in prominent positions in various parts of the Exhibition, and may be recognised by the unique "winged" design specially made and registered for the purpose of the Exhibition.

"Winged Clock of Wembley."

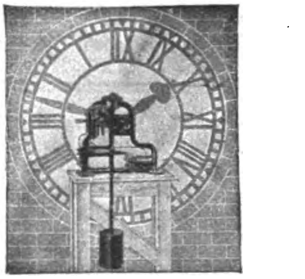
The time circuit on which these clocks operate, and which involves over 2½ miles of wiring, consists of ordinary 18-gauge electric light wire. This is stapled to walls, fixed in casings, run in tubes, and laid underground, and all the difficulties of wiring in modern works are met and surmounted.

The Time Transmitter driving all the "Pul-syn-etic" clocks, both in public positions and fixed on Exhibition stands, can be seen just inside the Watt Gate of the Palace of Engineering, at the base of the largest piece of plate glass in the world; and, incidentally, raising the eyes when looking at this Transmitter, one sees through the big sheet of glass an 18 in. diameter "winged" clock over the main entrance.

The complete arrangement of "Pul-syn-etic" clocks at the Exhibition demonstrates the important part which such a system plays in modern industry and commerce.

The energy required to operate the "Pul-syn-etic" transmitter and impulse clocks is so small that Leclanche cells are used for the purpose. The transmitter sends electrical impulses every half minute round the complete circuit, and thereby advances the hands of all "Pul-syn-etic" impulse clocks a corresponding degree.

These impulse clocks range from small 12 in. diameter clocks to larger sizes 36 in. in diameter. There are also four turret clocks. These latter clocks are *driven* by "waiting-train" movements in lieu of impulse movements to meet the requirements of large turret clocks having hands exposed to the elements, but for *time-keeping* they are controlled by the impulse transmitter. These waiting-train movements are of the same type as those driving the hands of the large clock on the Royal Liver Building, Liverpool, which, having four 25-ft. faces, is the largest electric clock in the world.



Waiting-Train Movement as Seen Behind Dials.

Not the least important feature of the "Pul-syn-etic" system is that existing workmen's recorders can be included in the time circuit by means of the patent "Reflex" control fitment, which ensures these instruments also keeping exact time with the other clocks in the circuit, and incidentally with each other, and maintaining throughout a factory, works or other industrial establishment "one factory—one time." Some of these "Reflex" fitments can be seen operating on workmen's registers at the exhibit of the National Time Recorder Co., Ltd., Bay 4, Avenue 5, of the Palace of Engineering, and it should be remembered when these are viewed that they are simply connected to the circuit on which all the "Pul-syn-etic" clocks, large and small, are operating.

The majority of visitors to the Exhibition are interested in industry in one way or another, and a point should be made of inspecting the tabloid exhibit of industrial "Pul-syn-etic" impulse clocks as used in industry, which will be found in the Horological Section of the Watch, Clock and Jewellery Section in the Palace of Industry.

This is well worth a visit, as the whole system is shown connected in circuit visible to the observer, as well as an entirely automatic programme of works' "start-and-cease-work" signals known as "time discipline apparatus."

Apart from the many exhibitors' stands which are equipped with "Pul-syn-etic" clocks as already mentioned, the clocks serving the general public are fixed in the following positions:—

Palace of Engineering.—The Watt Gate, the Arkwright Gate, the Kelvin Gate, the Railway Bay, Café East, Café West, Bank Café.

In the Grounds.—Grand Restaurant, Regent Restaurant, Harmony Buffet, Colonade Tea Rooms, Colonade Café, Old London Bridge (west entrance Tower), Old London Bridge (east entrance Tower), the Crosse and Blackwell Building, the *Times* Building, the South-West Entrance (one outside and one inside), Exhibition Station.

Market for Wireless Apparatus.—A confidential report on the market for wireless apparatus in various Central and South American Republics has been prepared by the D.O.T., and U.K. firms desirous of receiving a copy should communicate with the D.O.T., 35, Old Queen Street, London, S.W.1.

Cookstown (Co. Tyrone).—At a public meeting in connection with Cookstown Ratepayers' Association, Mr. George Ramsay presiding, there was a long discussion on the proposed lighting of the town by electricity. Ultimately it was decided to leave the matter in the hands of the Urban Council for the time being.

Rosario.—The Municipality of Rosario, Argentina, intends to invite tenders for the construction and working of an electric tramway system in that town. The opportunity to present a tender after a complete study of local conditions on the spot, which is, of course, essential, is only available to groups who are already conversant from experience with the conditions of operating municipal public utility enterprises in South America. Further particulars from the D.O.T., 35, Old Queen Street, S.W.1.

THE TRANSFER OF SUPER ELECTRICAL PLANT.

The science of materials handling has made very rapid strides within the last few years, until it might almost be said that the problem of moving a certain weight of a certain material from one situation to another is solved by consulting a curve or two on a suitable chart. But a problem far beyond the scope of curves and formulæ was that involved in the recent transport of a turbo-alternator stator from the Witton Works of the General Electric Co., Ltd., to the hold f the s.s. *Clan Mackellar*, which was to bear the stator from Manchester Docks to Sydney Harbour.

The turbo-alternator referred to is for Sydney Municipality, and has an output of 16,000 k.v.a., at a pressure of 5,400 volts, when running at a speed of 3,000 revolutions per minute. When it is realised that the power generated is in excess of 20,000 h.p., something will be realised of the order of the weight and dimensions which such a machine has to possess. In our illustrations Fig. 1 shows the arrival outside the Witton Works of the 30-ton forging for the rotor, while in Fig. 2 the 50-ton stator is shown safely secured to the special double-bogie truck provided for the purpose by the L.M. and S. Railway.

The total weight of the alternator was just over 80 tons, of which the stator claims 50 tons. Its overall dimensions are 12 ft. 9 in. long, 9 ft. 10 in. high, and 10 ft. 7 in. in breadth, and from these figures it will be appreciated what a huge mass had to be dealt with when it was necessary to transport it to the railway siding. Although the distance is small, it took nearly five hours to perform the journey, due to the great risk of the wheels of the lorry, on which it was taken, sinking into the roadway and possibly damaging the various service mains. So, to prevent any such calamity, it was necessary to lay steel plates beneath the wheels for this section of the transport, and it was the continual relaying of this emergency metal track which caused the initial stage of the journey to be so tedious.

The transfer of the stator from the lorry to the railway truck involved a large amount of preliminary organisation. Perhaps the most important feature of such work was the provision of the two largest cranes possessed by the L.M. and S. Railway (north-western section), these being specially brought down from Crewe for the occasion; while yet another consideration was obviously how the machine should travel to Manchester. A truck was selected of the double-bogie pattern, which has been built at the L.M. and S. Railway Waggon Works, Newton Heath. Its general design is seen in Fig. 2, which shows the stator as finally secured to the truck ready for its journey.

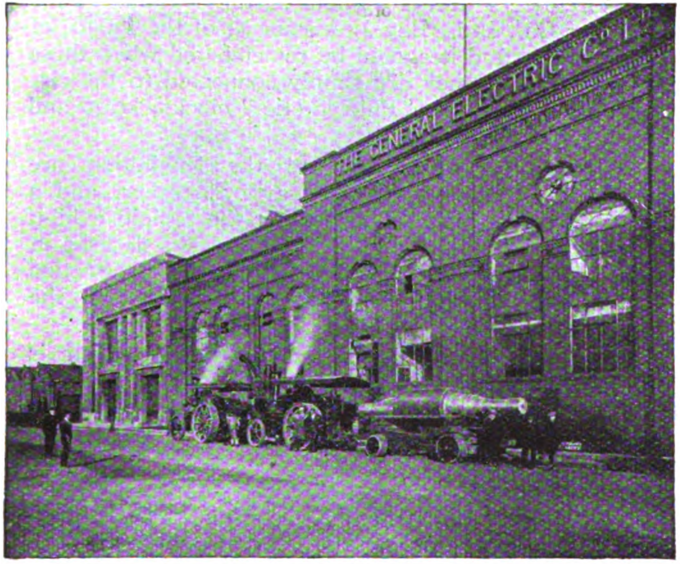


FIG. 1.—THE 30-TON FORGING FOR THE ROTOR ARRIVING AT WITTON WORKS.

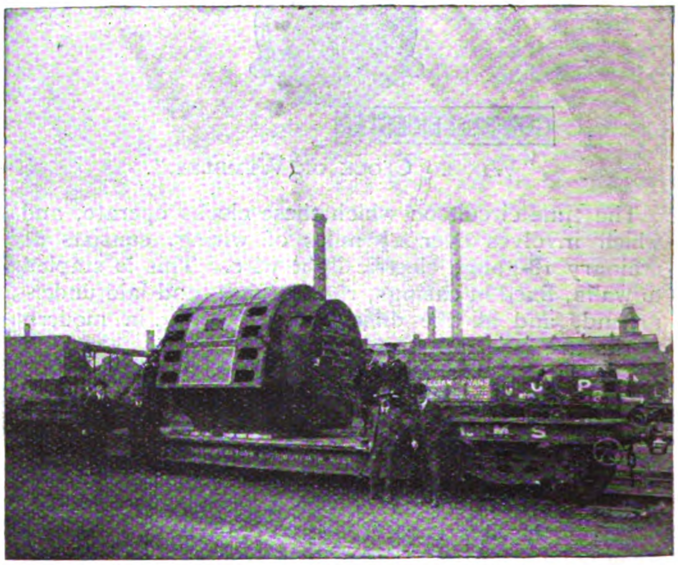


FIG. 2.—THE 50-TON LOAD SAFELY SECURED TO THE SPECIAL TRUCK.

The actual lowering of the stator on to this truck was another somewhat tedious operation, as it was necessary to ensure perfect balance and distribution of weight; also, during the journey to Manchester, which was by special goods train, careful watch had to be kept over this hefty passenger. Arrived at Manchester Docks, it had to be similarly handled by special floating cranes, and it is worth recording that the entrance to the hold was only just of sufficient dimensions to admit it.

The safe transport of such a huge piece of apparatus reflects great credit upon all those concerned, and it should be added that the L.M. and S. Railway sent several experts in transport to ensure that no hitch should occur at any stage of the proceedings.

Tenders Accepted.—The Siemens and English Electric Lamp Co., Ltd., have secured an order for a large quantity of lamps for illuminating the whole of the N.W. Garden of the Wembley Exhibition.

Obituary.—Yet another of the former staff of the old firm of Woodhouse and Rawson has passed away in the person of Mr. J. R. Bainton, who died recently in Australia. For nearly twenty years he acted as Australian representative of Dick, Kerr and Co.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of

CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N. 17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

Exchange and Mart.

"Wanted to exchange one oscillating fan only used once, during alleged summer (1924), for efficient bowl fire." This imaginary announcement about summarises the climate which we Britishers have had to endure for the past six months or so, and it really is time the manufacturers and vendors of electric heating appliances got busy on their winter campaign. There is plenty of opportunity at the time of writing for the sale of all kinds of aids to artificial warmth. At the B.E. Exhibition, for example, the most popular exhibits at the present time are the various electric fires in actual demonstration, coupled with the boiler house adjacent to the power station, where some little comfort is derived from the furnaces by passers-by. One shudders at the idea of those large and exposed buildings during October and November if the proposed extension to Armistice Day becomes effective; the problem of keeping warm will become a very real one to some stand attendants, especially those located near the ever-open doorways. Apropos the proposed Armistice Day closing, there is no truth in the rumour that the suggestion arises out of the existing warfare between exhibitors and the administration, to which the proposed date would afford a fitting climax.

The Leeds Decision.

The recent King's Bench decision on the Leeds case, to the effect that members of town and city councils are held to be disqualified from their office if companies of which they are directors or managing directors hold contracts with the corporations of which they are members has caused quite a fluttering alike in municipal and manufacturing dovecotes. Although making for ideal purity in municipal trading, the decision is anomalous, in that it debars from corporate office just the shrewd type of business man who is most wanted in our town and city councils. Most of the ills from which municipalities suffer are directly traceable to the ineptitude of the average councillor and committee man, drawn as a rule from the ranks of local tradesmen of retail, and therefore limited, experience, or from such professional classes as the law, medicine, the church, etc., and correspondingly lacking in the experience and ability to govern a large community to its advantage.

Experience of the working of the new edict so far goes to show that it will prove distinctly detrimental to the ratepayers, in that local firms and contractors of local standing will be debarred from carrying out municipal contracts or supplying municipal requirements by reason of the fact that prominent members of these firms at present serve as councillors. Already at Bath there has been a withdrawal from an important contract to the tune of some £30,000 by a well-known firm, one of the principals of which is an alderman of the city. Curiously enough the next lowest tenderers are also disqualified by the fact that one of their principals is also an alderman, and the net result is that a tender some £4,000 higher than that originally accepted will have to take precedence, the resultant charge on the local ratepayers amounting to an additional 2½d. rate.

Public Lighting.

It scarcely seems a year since we first commented in glowing terms upon the constitution of the Institution of Public Lighting Engineers and Superintendents, yet preliminary announcement has just been made of the first annual meeting of this body. The projected dates are Tuesday and Wednesday, September 16 and 17, and the venue is Glasgow. Members and delegates will be officially received by the Corporation and entertained to luncheon in the City Chambers. Subsequently there will be a presidential address, and a number of interesting papers bearing on this vitally important subject of public lighting will be read by well-known authorities. On the Thursday a visit to Edinburgh has been arranged, including a drive round the city for the purpose of inspecting the different methods of public lighting in vogue there. The I.P.L.E.S. is yet too young to have accomplished any noteworthy reform in our admittedly obsolete systems of lighting public thoroughfares, but they have plenty of scope for the exercise of their activities, and by the time the next annual meeting is due we may confidently look forward to some practical achievement marking their advent and spirit of enterprise.

Totally Enclosed Motors—the Need for Inspection.

Recent experiences with a small dynamotor of the totally enclosed type prompts the suggestion that this type of machine should be subjected to a fairly frequent inspection and overhaul if early breakdown is to be avoided. One such machine which had been running continuously during the daytime for upwards of four months stripped a pinion on the driving shaft which meshed with certain gearing driven by the motor. The repair necessitated taking the machine to pieces and abundantly demonstrated the need for this warning. When the armature was withdrawn from its polar tunnel the original clearance was found to be almost entirely taken up by a mixture of fine carbon dust and grease worked up from the commutator and brush gear. This had piled up at the commutator end and been gradually drawn into the tunnel until it was almost acting as a brake upon the whole length of the armature and would eventually have caused a bad burn-out.

In these totally enclosed machines close inspection from the outside by way of the brush inspection covers is generally impracticable and it is almost always essential to dismantle the machine in order to ascertain its internal condition. With modern accessible designs this does not involve any very serious delay, and the case under review certainly demonstrates the necessity. Due to the enclosure, there is no clearance for the egress of dirt, fluff, or carbon dust from the brushes, which must inevitably remain inside the machine and grow in volume in proportion to the period during which the motor is kept in service. The same type of motor is largely used for driving electric fans and other small-power devices and I shall be interested to hear whether other users among my readers have experienced breakdowns or faults due to causes similar to those above outlined.

Tramway Losses—A Contributory Cause.

In an interesting and instructive article in the *Tramway and Railway World*, Mr. T. C. Way shows with the aid of graphs and tables how the average electric tramway working costs per car-mile have appreciated during the past twenty to twenty-five years in the case of several of the leading undertakings. He further points to a probable cause for some of this heavy increase in the wear and tear of permanent way and wheel tyres whereby a heavier load is placed upon the system so gradually as to be almost imperceptible until its accumulated effect becomes apparent over several years' working of the system. It must obviously require a greater expenditure of energy to propel a loaded tramcar over rails which have so worn that their upper bearing surfaces present a considerable slope or angle with the horizontal, and in which the corresponding grooves have widened due to wheel flange friction and slip.

With the aid of laboriously calculated statistics of working costs of about a third of the systems which publish their annual figures, Mr. Way estimates the annual additional expenditure on increased power consumption due to this cause to be no less than £364,000, or at the rate of 0.826d. per car-mile additional. Applying this figure to the remaining systems, he estimates that an annual outlay of at least £1,000,000 must be incurred, owing to the increase in power now necessary as compared with original working costs when wear and tear had not taken their toll of the permanent way and rolling stock. There are an equal number of systems for which no figures are available, so that, taking the total tramway systems of the country, two millions sterling annual loss would probably be nearer the mark. As this loss tends to increase year by year, and already one-fourth of the systems which publish their finances are acknowledging a loss, the serious aspect of the question is at once apparent. Mr. Way urges the tramway associations to take up the question of a practical remedy without delay.

"Drop" the Foreman.

Under the above title a writer in *Contact*, the monthly official journal of the N.A.S.E., exposes a reprehensible practice which prevailed at Wembley during the rush period of preparing for the official opening, viz., that of exacting a weekly charge from the employees under them by the various foremen as a fee for being permitted to hang on to their jobs. This is bribery and corruption with a vengeance, and is stated to have been considerably practised while the supply of labour exceeded the demand. During the high-pressure period just before the Exhibition opened there was a lull—the demand exceeded the supply, and the extortion could not easily be maintained. When the pressure ceased the bribery recommenced. As the writer points out, the best workmen are generally the best thinkers, the best principled and are, therefore, under this cankerous system, the last to be employed and the first to be sacked. It is up to all employers to withhold employment from every foreman or charge hand found practising this degrading form of petty tyranny.

Elektron.

THE G.E.C. AT THE ALL-BRITISH WIRELESS EXHIBITION.

At the great All-British Wireless Exhibition at the Albert Hall, the G.E.C. are staging a complete range of "Gecophone" broadcast receiving sets, including a new range, consisting of one-, two- and three-valve sets in flat and cabinet forms, the two- and three-valve models employing detector and low-frequency amplification only, and being specially designed for listeners requiring reliable and easily manipulated apparatus. The sets embody several new features, and the two- and three-valve sets will give sufficient volume to operate loud-speakers. While maintaining the high quality associated with "Gecophone" products, these sets are offered at extremely attractive prices.

There is a new Gecophone five-valve cabinet set, having three stages of L.F. amplification, resistance-capacity coupled, and specially designed for distortionless reproduction, and to be an ideal instrument for use in conjunction with loud-speakers. One- and two-valve amplifiers for use with existing sets are also exhibited, together with the now highly popular "Gecophone" loud-speaker.

In addition they show a full and extended selection of the well-known "Gecophone" components and accessories which cover fully the requirements of experimenters and home constructors. A new type of intervalve transformer, for which is claimed extremely distortionless magnification over the whole audio-frequency range, will attract considerable attention, as also will a very neat form of vernier condenser, which takes up the minimum of space and may be conveniently added to any existing set.

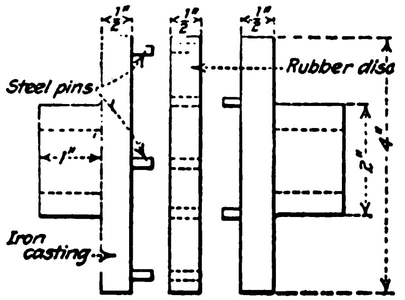
A 4 pp. circular issued by **David Carlaw and Sons, Ltd.**, of 31, Finnieston Street, Glasgow, illustrates the special patterns of elevators and conveyors which they manufacture for use in newspaper offices.

Practical Electrical Engineering Hints.

We cordially invite all our readers to contribute to this interesting and useful feature. All hints received will be given careful consideration and will be paid for at our usual rates.—The Editor.

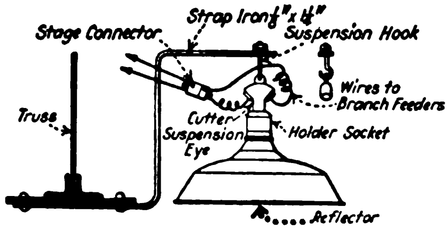
No. 1.—How a Flexible Coupling was Constructed at Small Expense.

An inexpensive coupling of home-made design can be easily constructed, as it was in my case. The coupling is composed of three discs, two cast iron and the third, the centre one, of rubber. In the cast-iron discs holes are drilled and tapped as shown in the sketch; steel pins fixed in these holes complete the job. Holes are drilled in the rubber disc into which the pins pass. This arrangement is very suitable for small motors; the coupling is quite flexible and the rubber can be readily replaced when the holes show signs of wear.—" W. B. A."



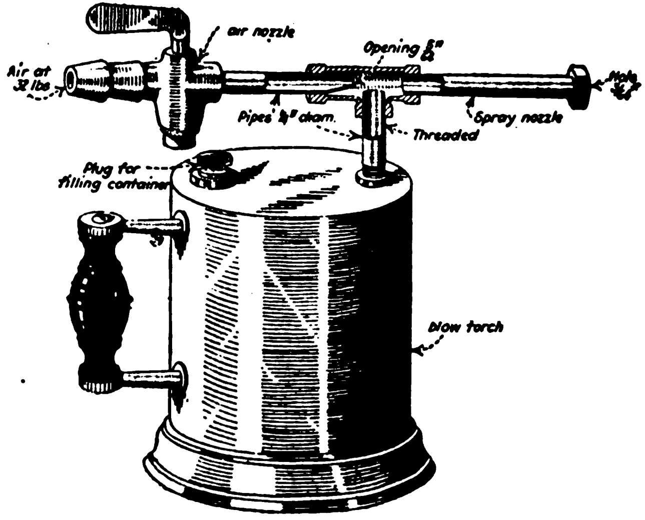
No. 2.—How a Lighting Unit was Placed Out of the Way of a Crane.

In our foundry the lighting units were continually fouling the overhead traveller if the driver was not very careful. What I did was to mount the units on a piece of iron strap in the manner shown in the sketch. In this position the reflector cannot foul the crane, yet it can be easily reached from the crane platforms. The chief feature about this job is the connecter, which allows the unit to be removed from its position quite easily when being cleaned.—" S. H. G."



No. 3.—How a Blow Lamp was Converted into an Air Brush.

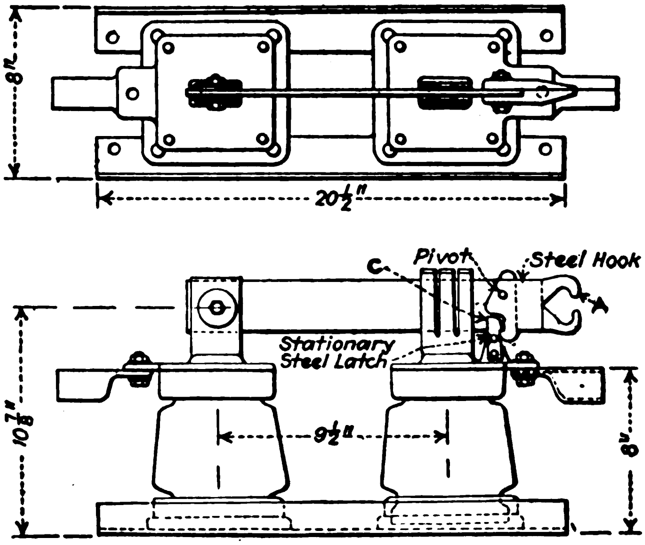
The burner was removed from the torch and a nozzle was inserted, the latter being made of three pipes ¼ inch in diameter. One pipe was connected to an air supply, this passing through a 5-64 inch opening and passing as a jet across the top of the vertical pipe, which is screwed into the top of the lamp. When this lamp is filled with insulating varnish the suction raises the varnish in the vertical pipe and the jet of air forces it into the second horizontal pipe and through the 3-64 inch hole in the nozzle. An air nozzle or valve, to regulate the flow of air, completes the job.



This arrangement will be found to be very satisfactory for giving a finishing touch to the varnishing of armatures, rotor and stator windings, in fact, in any case where it is desired to reach the bottom of small crevices.—" R. H. N. L."

No. 4.—How H.T. Switches can be Opened without Straining the Supports.

The sketch illustrates both plan and elevation of this device. A lever action starts the switch to open without the use of much force. The switch has a steel hook pivoted to the end of the blade and, when closed, the hook engages with a steel latch fixed to the insulator. When the switch is opened, the operator



pulling on the hook at the point A, unlatches the switch through the lug on the hook pushing against the steel latch at the point C. This moves the switch contracts about $\frac{1}{4}$ inch, thus making it easy to pull the blade the rest of the way from the contact. This device will be found to be very satisfactory on H.T. cellular type switchboards where space is limited.—"G. S. H."

ELECTRICAL INSTALLATION WORK.

By C. Sylvester, A.M.I.E.E., A.M.I.Mech.E.

Solutions to the Questions in Grade I. Examination on May 6th, 1924.

Q. 1—What is a transformer? Explain how it works.

A.—A transformer may be said to be a single magnetic circuit which is linked with two independent electrical circuits. Fig. 1 illustrates an iron core, *C*, which, when energised, provides the magnetic circuit through two electrical circuits, *P* and *S*, which may be considered as the primary and secondary coils. The coils have no electrical connection with each other, and are insulated from the iron core. The object of the transformer is to transform A.C. voltage from one value to another.

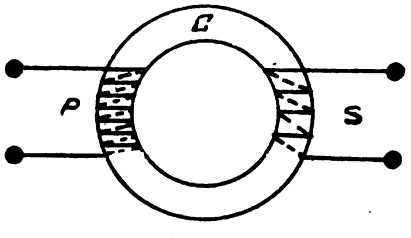


Fig. 1.

The action of the transformer is as follows:—If a direct current is applied to *P* no voltage will be induced in *S* after the switch is closed. If, however, an alternating or varying direct current is applied to *P* a current will flow in *S*. If *S* is on open circuit there will be practically no current flowing in *P*, because the fluctuation in current causes a fluctuation in magnetism, and the latter, in cutting the turns of *P*, causes a voltage to be produced in *P* which is opposite to that which produces the current. If, however, *S* is closed, a current will flow through the circuit, since the coils are linked with the same flux which is produced by *P*. As the magnetism fluctuates in *S*, however, a counter electro-motive force is induced into it, and this reacts upon the magnetism produced by *P*. The result is that the back electro-motive force of *P* is reduced and additional current is taken from the mains. The efficiency of a transformer is very high, so that the voltage across *P* and *S* is practically in proportion to the ratio of the turns in the coils.

Q. 2.—Why does an engine consume more fuel when driving a dynamo at full load than at half load?

A.—When a dynamo is under load, its load at any time is proportional to its watts output, this being determined by the product of the volts and amperes. All fuel has a certain calorific value, and the unit (the calorie) can be connected to the watt or H.P. in several ways. The *Joule*, for instance, is a watt-second, and this is equal to 0.24 calorie. Again, 746 watts is equal to one H.P., and this is represented by 33,000 foot-pounds. One joule is, again, equal to 0.737 foot-pound, so that, from what has already been written, it will be seen that 0.737 foot-pound is equal to 0.24 calorie. If, therefore, the joules increase at the dynamo end due to increased load, the calories must increase, since there is a definite proportion in their values.

(*To be continued.*)

TELEGRAPHY.*

Being solutions to the questions set at the Grade I. examination in Telegraphy held by the City and Guilds of London Institute on April 30, 1924.

(*Continued from page* 455.)

Q.—What is meant by retardation and prolongation? Give a diagram of two stations, double current simplex, worked on the universal battery system. Show by means of arrows the path of the current when one station is sending.

A.—A telegraph circuit may be regarded as a condenser in which the wire forms one conductor, the earth (or, in the case of a loop circuit, the return wire) the other, and the intervening air or other insulating material the dielectric. It is owing to the fact that a telegraph circuit possesses electrostatic capacity as well as resistance that the application of a battery at one end, as in single-current working, does not result in an immediate rise of the current at the receiving end to its full working strength. A certain interval of time elapses between the first application of a signal at the sending end and its arrival at the receiving end, depending directly upon the capacity and resistance of the circuit and also upon the sensitiveness of the receiving instrument. This delay in the arrival of signals is termed retardation. If the battery is applied for a very short period, as in the case of signalling a dot, the received current over lines of high capacity may not reach a value sufficient to actuate the instrument, because the major portion of the current may be used up in charging the line. When the sending key is raised, the charge on the line flows to earth at each end, and, as the direction of discharge at the receiving end is in the same direction as the signalling current (see Fig. 8), the result is to cause a "prolongation" of the signal.

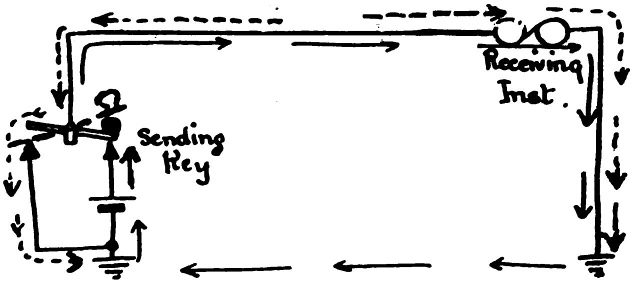


Fig. 8.

Referring to Fig. 8, the full arrows show path of signalling current when sending key is depressed. The dotted arrows show discharge currents when sending key is raised.

---

* Books recommended are:—*Questions and Solutions in Telegraphy and Telephony, Grade I.*, by Few (Rentell, 5s. 10d., post free), and *The Telegraphists' Guide*, by Bell and Wilson (Rentell, 3s. 10d., post free).

Fig. 9 is a diagram of two stations double-current *simplex* worked on the universal battery system. The path of the current when the UP station key is depressed is shown by the arrows.

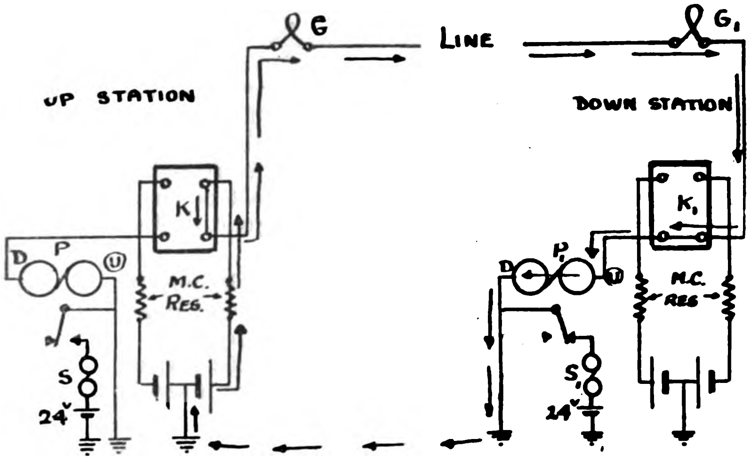


FIG. 9.

In Fig. 9—

G and G_1 are single current galvanometers.

K and K_1 are single-current keys with switches. K has its switch in the "send" position, and its key lever depressed. K_1 has its switch in the "receive" position.

P and P_1 are polarised relays.

S and S_1 are 900 ohm sounders worked off 24^v local batteries.

(*To be continued.*)

ELECTRICAL ENGINEERING.—FINAL GRADE*.

Solutions to Questions set at the 1924 Examination of City and Guilds Institute.

BY EDWARD HUGHES, B.SC., A.M.I.E.E.

(*Continued from page* 456.)

Q. 2.—An induction motor, insulated from earth, has properly insulated stator and rotor windings. It is found that a shock can be obtained from the stator core when the motor is connected to the mains. What is the probable cause of this, and how might it be avoided without earthing the frame?

A. 2.—It is presumed that the induction motor is of the three-phase type; and for simplicity it will be assumed that the stator winding is star-connected. Since the frame of the motor is insulated from earth, and since the three stator phases are symmetrically placed relatively to the core, the potential of the latter is approximately the same as that of the star point of the stator winding.

If the supply system has an insulated neutral, and if the three phases of the alternator and of the mains are perfectly symmetrical relatively to earth, the star point of the alternator and therefore the motor-frame are at earth potential, and no shock is possible from the frame. On the other hand, if the insulation resistance of the three line conductors, say, are unequal, the potential of the star point oscillates above and below the earth potential. Thus, if on a three-phase system with 400 volts across the line conductors, the insulation of one of the latter breaks down, the maximum potential of the star point above and below earth is $\frac{400}{1.73} \times 1.414$, namely 327 volts. It would therefore be quite possible to receive a shock from the motor frame.

The trouble can be eliminated by definitely earthing the star point of the alternator. It will, of course, be obvious that with an earthed neutral, a faulty line conductor must be cut out of circuit if the earth current becomes excessive, or some form of balanced protection must be provided to disconnect a line having an incipient fault.

Other causes of the phenomenon described in question suggest themselves, but in the absence of more complete information the above explanation appears to be the most probable.

Q. 3.—Power is transmitted over (*a*) a two-wire, single-phase line, (*b*) a three-wire, three-phase line with the conductors arranged in an equilateral triangle. The cross-section, the distance between wires, and the voltage between wires is the same in both cases. Assuming the same percentage impedance drop and the load power-factor in (*a*) and (*b*), calculate the relative amounts of power that can be transmitted.

A. 3.—Let $V =$ line voltage at receiving end.
$R =$ resistance per unit length of single conductor.
$X =$ reactance per unit length of single conductor.
and $l =$ length of transmission line.

Since the distance between the wires is the same in each case, the value of X is also the same.

Let $I_1 =$ current with single-phase system,
and $I_2 =$ line current with three-phase system,
to give same percentage impedance drop.

$$\left.\begin{array}{l}\text{Total impedance drop}\\ \text{for single-phase system}\end{array}\right\} = 2 I_1 l \sqrt{R^2 + X^2}$$

$$\therefore \left.\begin{array}{l}\text{impedance drop for single-}\\ \text{phase system as percentage}\\ \text{of line voltage at receiv-}\\ \text{ing end}\end{array}\right\} = \frac{2 I_1 l \sqrt{R^2 + X^2}}{V} \times 100$$

$$\left.\begin{array}{l}\text{Impedance drop per line}\\ \text{for 3-phase system}\end{array}\right\} = I_2 l \sqrt{R^2 + X^2}$$

If the load be assumed to be star-connected, the impedance drop in a line conductor is also the impedance drop per phase,

$$\therefore \left.\begin{array}{l}\text{impedance drop for 3-phase}\\ \text{system as percentage of } \textit{line}\\ \text{voltage at receiving end}\end{array}\right\} = \frac{1.73 I_2 l \sqrt{R^2 + X^2}}{V} \times 100$$

For equal percentage impedance drop, we have—

$$\frac{2 I_1 l \sqrt{R^2 + X^2}}{V} \times 100 = \frac{1.73 I_2 l \sqrt{R^2 + X^2}}{V} \times 100$$

$$\therefore \frac{I_1}{I_2} = \frac{1.73}{2}$$

But power transmitted by single-phase system $= I_1 V \cos \phi$

---

* Books recommended are *Continuous Current Electrical Engineering* and *Alternating Current Electrical Engineering*, both by Maccall (each 15s. 6d., post free), and *Alternating Current Electrical Engineering*, by Kemp (17s. 6d., post free), from S. Rentell and Co., Ltd., 36, Maiden Lane, London, W.C.2.

and power transmitted by three-phase system $= 1.73\, I_2\, V \cos\phi$

$$\therefore \frac{\text{Power transmitted by 1-phase}}{\text{Power transmitted by 3-phase}} = \frac{I_1\, V \cos\phi}{1.73\, I_2\, V \cos\phi} = \frac{1}{2}$$

(*To be continued.*)

Questions and Answers by Practical Men.

RULES.

Questions: We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.

Answers: A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

Question No. 188.

I have under my charge a large number of mercury motor-meters for overhauling and calibration. I would like some details as to how I can clean mercury with acid and subsequently distill it in vacuo. Any other method of purifying mercury will be helpful. I have been sending the mercury to Johannesburg to a chemist, but I wish to do the cleaning myself.—John J. Wud, Witenhage, C.P. South Africa.

Question No. 189.

Can you give me a reliable method of adjusting the ordinary microphone transmitter (carbon) fitted to magneto ringing telephones fitted with induction coils in a private exchange?—"Magneto."

(Replies to Questions Nos. 188 and 189 must be received not later than September 27, 1924.)

Answers to Questions.

Question No. 182.

In the event of a 20 h.p. d.c. motor failing through no apparent cause, what tests should be carried out to locate the defect? State the tests in their correct order.—A. N. Butler (Wolverhampton).

Replies to Question No. 182.

The first prize (10s.) has been awarded to "S. J. Berryman, Gustavus Road, Camborne, Cornwall," for the following reply :—

Having had a good many years' experience in the installation and maintenance of electrical machinery of all descriptions, I think a motor failing through no apparent cause shows the trouble must be of a minor nature; so, perhaps, it will be just as well if we consider the question from a broad standpoint, irrespective of the outward appearance of any trouble, and deal with the subject as a direct-current motor running under normal conditions, suddenly stops, and possibly fails to start when the starter or resistance handle is again operated.

The first thing that comes to our mind would be a failure of the supply. We can soon set our minds to rest on this point if we switch on our pilot lamps, which are very conveniently fitted to each motor switchboard or panel, and are much better than handling test lamps. If it is not possible to obtain a light, of course the trouble is found.

But let us suppose the supply of current has not failed; the trouble may be overload. This means either the fuse or fuses has burnt out, or the overload trip has come into action. Fuses can easily be replaced, and I always make it a point to keep a set of spare fuses on each switchboard, as it saves a great deal of time in a large installation.

On looking at the overload trip setting it may be found to be operating at too low an amperage; if so, this can easily be remedied, but if the safe point is reached the only thing to do is to remove the surplus load. If the overload is temporary, of course it would not be necessary to remove any.

Overload may result from tight bearings on line shaft, additional machines installed, or present machines doing heavier work, and various other causes.

Another reason for the blowing or burning out of the fuses is flashing over on the commutator. This is often caused by the commutator getting dirty, through, perhaps, the carbon brushes being of too soft a nature, or the mica segment insulation standing above the copper. The cause of the latter is hard mica and soft copper, the remedy being cutting down the mica or turning down the commutator.

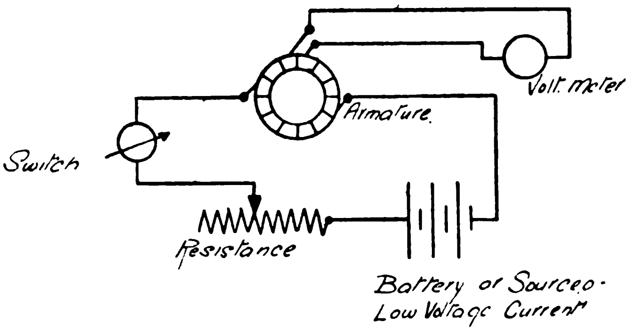
Another cause may be bearing trouble, when oil rings are used. As the majority of motor bearings are cast-iron or brass shells lined with anti-friction metal and lubricated by a brass ring running loose on the shaft and taking oil around with it from an oil well, it is quite possible that the rings may become stationary through using oil of too heavy a nature, or dirt getting into the bottom of the well; this, of course, resulting in the shaft running dry in time. The metal would now get hot and run out of its shell, the armature gradually dropping down on the pole pieces, giving an unequal torque, and, perhaps, doing serious damage to the winding.

We will now presume that none of the aforesaid troubles have happened. We will look at the field coils, but nothing wrong strikes the eye. It may be that the field circuit is broken; now we must test for continuity. This can easily be done by test lamps. Connect one end of your field circuit to the supply, and put a pair of lamps in series with the field winding. If a light results, of course everything is correct; if not, the field circuit is broken; and each coil should be tested separately the same way as before, making sure if the coils are taken out of the motor casting that they are replaced in their correct position of polarity.

Now, one thing more remains to be examined in the motor, and that is the armature winding. Perhaps a coil or coils are burnt out, or a connection is broken at the commutator. The latter can easily be traced by the burnt commutator bars, and, when found, should be resoldered, using silver solder for the purpose.

It sometimes occurs, though very seldom, that there is a break in the armature coil itself. This may be found by the following method :—

The armature is connected in series with a resistance and switched on to a low-voltage current, as per sketch.



If a batter or sufficient voltage is not available, or the current from the mains too high, a bank of lamps wired in series or series parallel may be used, or a shunt resistance. The voltage between any two consecutive bars should now be measured by a voltmeter. An abnormally large voltage between two adjacant commutator bars indicates an abnormlly large resistance, if there is any break in the armature winding; the full voltage will be indicated between those commutor bars between which the break exists.

In such a case rewinding the armature is generally necessary, and the only remedy. As a temporary repair may be required, the two commutator bars or coils between which the break exists may be connected together by using a bridging piece, provided the number of commutator bars is not too small. Only in a case of emergency should this course be adopted, but sometimes a very undesirable stoppage is thus prevented.

After making the tests mentioned, and the motor is found not to develop any faults, it would be advisable to examine the starting resistance, where one or more coils may be broken or burnt out. If so, this trouble can easily be seen and needs no testing, the remedy being to fit new coils.

Another starter trouble may be a broken connection or break in the winding of the no-volt release coil. Perhaps it would be just as cheap to fit a new coil in the case of the latter as it would be to repair same.

The order in which to carry out the tests are, perhaps, best left to the engineer in charge, as everyone knows their own machines with their own peculiarities the best.—"S. J. Berryman."

The Second Prize Winner's reply will be published in due course.

Poland.—A confidential report on the market for wireless apparatus in Poland has been prepared by the D.O.T., and U.K. firms desirous of receiving a copy, together with full particulars of the Special Register service and form of application for registration, should communicate with the Department at 35, Old Queen Street, London, S.W.1.

France.—The report on the economic conditions in France, which has just been published by the Dept. of Overseas Trade (price 6s. 3d. post free from H.M. Stationery Office or Electricity office), contains much matter of interest to electrical manufacturing firms who desire to promote trade with our allies. It is evident that France is very busy, and there is practically no unemployment, so there should most certainly be a demand for a fair amount of English electrical apparatus.

WEMBLEY ELECTRICAL CARNIVAL AND DANCE.

On Wednesday, September 17, all electrical men ought to visit Wembley, and take active part in the electrical carnival and dance which is being organised by the exhibitors in the Electrical Section of the Palace of Engineering.

To open the evening's amusement, a procession of gaily decorated electric vehicles and fancy dress models of electrical appliances will start from the Faraday Gate, and will wend its way round the Exhibition until it arrives at the Great Palace of Dancing in the Amusements Park, about 8 o'clock, when dancing will commence to the strains of the British Empire Exhibition dance band, which has been specially engaged for the purpose.

Visitors in fancy dress, representing some electrical device or symbol, will be specially welcomed, and it is hoped that such visitors will take part in the procession itself around the grounds.

Special competitions will be held during the evening for the best fox-trotting couple and the best fancy costume. Other special contests will be held, and valuable prizes will be presented to the winners.

It should be clearly understood that everyone connected with the electrical industry in any capacity, together with relatives and friends, is cordially invited to take an active part in the proceedings, and in view of the fact that this is the one occasion during the whole of the Exhibition when a special electrical night of this character is possible, it is confidently expected that the attendance of electrcal visitors will be a record one.

Tickets, at a price of 6s. each, which includes admission to the dance hall and refreshments during the evening, can be obtained on application to Mr. Gillott, E.D.A., Avenue 13, Bay 1, Palace of Engineering, Wembley; the *Electrical Review*, 4, Ludgate Hill, E.C.4, and Mr. Gibson Young, B.E.A.M.A., Avenue 15, Bay 8, Palace of Engineering, Wembley.

Early application for tickets is particularly desirable.

Those responsible for the organisation have already received promises of whole-hearted support from the majority of the firms exhibiting in the electrical section, and many of them have undertaken to arrange that members of their staff shall represent them in fancy dress, in the procession which is to parade the Exhibition.

To any firms who have still held aloof, a special appeal is made to assist in every way to make a complete success of a function which, so far as the procession is concerned, will undoubtedly be regarded as representative of the industry, in its various functions of supply, manufacturing and contracting, by the large crowds who are expected during the carnival period. Obviously the value of a direct appeal in this fashion to many thousands of people cannot be over-estimated.

The members of the Incorporated Municipal Electrical Association will be at Wembley in considerable force on the carnival day, and will no doubt add to the numbers taking part in the festivities.

By those intending to take part it should be specially noted that evening dress is optional, and is not essential, since many who have been at Wembley all day will have little opportunity or desire to change into the costume of convention.

Once again we would make it clear that everyone connected with the industry, and who may find himself (or herself) free on Wednesday, September 17, is cordially invited and expected to be present, so that this unique opportunity of meeting old friends and making new ones may not be missed.

Various Items.

Wireless Apparatus in Finland.—A confidential report on the market for wireless apparatus in Finland has been prepared by the D.O.T., and U.K. firms desirous of receiving a copy should communicate with the D.O.T., 35, Old Queen Street, London, S.W.1.

Severn Barrage.—The Government has decided to proceed at once with certain preliminary investigations in order to ascertain the feasibility of the scheme for using the tidal power of the River Severn for the production of electrical power by the erection of a barrage across the river, and Lord Parmoor, to whose scientific department (the Department of Scientific and Industrial Research) the work has been entrusted, has already made arrangements to put the investigations in hand.

"**The World's Messenger**."—This is the title of a beautifully printed 32 pp. pamphlet which has just been issued by the Western Electric Co. It deals in an interesting and historical sense with the development of the company's works and manufactures in this country from the early days of 1883 with a staff of three men at 59, Moorgate Street, to the present date, when, in addition to the enormous works at North Woolwich, there is a factory at Bexley Heath, another at New Southgate, a large stores at Stratford, and an additional establishment at Eltham, with splendid offices at Connaught House, and branches in the leading cities of Great Britain, as well as in the principal British Colonies and foreign countries. It is lucidly written, and opens with a brief résumé of the attempts which have been made by man, since the dawn of time, to communicate with his far distant brethren. It touches on the beacon lights of the ancient Greeks, the trumpets used in the Roman amphitheatre, and the carrier pigeons of Richard the Lionheart, followed by the birth of printing in 1440, down to the discovery of the telephone by Alexander Graham Bell in 1875. The illustrations show many of the principal telephone exchanges which have been built by the company in the leading cities of the world, as well as of the work which is being carried out in the way of laying power cables for a working pressure of 33,000 volts. Wireless apparatus has much attention, and a brief account is given of the opening ceremony of the British Empire Exhibition, in which the company's public address system was installed and used. Other illustrations show their stand at Wembley, the experimental wireless hut at New Southgate, the interior of Westminster Abbey, and two charming specimens of Chippendale cabinet sets. Altogether the booklet is one which it is a real pleasure to read, and we can strongly recommend it to our trade readers as being well worth writing for.

FOR
TECHNICAL BOOKS
of all descriptions
send enquiries to
S. RENTELL & Co., Ltd.,
36, Maiden Lane, London, W.C.2.
'Phone Gerrard 2460 and
ask for our catalogues.
30 YEARS' EXPERIENCE

BRITISH MICA Co., Ltd.
(Contractors to H.M. Government.)
ELECTRICAL INSULATING MATERIAL MANUFACTURERS
15, Cardington Road, Bedford.
MICA, COMMUTATOR SEGMENTS, MICANITE SHEETS, TUBES, RINGS, WASHERS, MICA POWDER, FIBRE, PRESSPAHN AND INSULATING, PAPERS, CLOTHS, TAPES, &c. MICA IMPORTERS

Enniscorthy (Co. Wexford).—The Urban Council has accepted a tender for the erection of a power station in connection with the new electricity scheme at £1,395 10s.

Quotations Wanted.—Tenders are invited for the supply, delivery and erection of three electric portal cranes for quay service at the port of Ghent. Specifications, etc., from the D.O.T. (Room 52), 35, Old Queen Street, London, S.W.1.

The Northampton Polytechnic Institute.—We are in receipt of the "Announcements" of the above Polytechnic for the Session 1924-1925. We are sure our readers will be interested when we say that day and evening courses in Engineering (Civil, Mechanical and Electrical) are provided, in addition to Optical Engineering and Applied Optics. The Engineering courses include sub-sections in Automobile work, Aeronautics and Radio-telegraphy. In addition there are evening courses in Electro-chemistry, Metallurgy and Domestic Economy. The classes for the day courses commence on Monday, September 29, and those for the evening courses on Monday, September 22. Enrolments for the latter commence a week earlier.

Fire Prevention.—Dr. Waldo, at a recent inquest, said the City Corporation had decided to distribute his fire cards and the large poster notices to every citizen throughout the City. Fire defence in Great Britain cost £25,000,000 annually and the fire brigades about £2,000,000 every year. Insurance cost £21,000,000 annually. Four hundred lives on an average were lost every year, while 1,000 persons were injured by fires. If this great loss of life and property were to be arrested it would be well for the people to see that the recommendations of the Departmental Committee of the Home Office were included in the Amending Coroners Bill promised by the Home Secretary in the House on July 31, 1924. The Committee unanimously recommended that the benefits of the City system of fire inquiry as carried out by the City Coroner in accordance with his provisions of the City of London Fire Inquests Act of 1888 should be extended to the country at large. At present he (Dr. Waldo) was the only Coroner or person in the United Kingdom whose duty it was to investigate fires (non-fatal and fatal), the cause and all the circumstances of such fires, and to commit in proper cases for the crime of arson or incendiarism, for trial directly on inquisition before a judge or common jury. Lives once lost, and valuable property once burnt, could never be recovered, and the tax on the nation by insurance was enormous and in large part unnecessary if only (1) judicial fire inquiries were generally instituted, and (2) children were educated in fire precautions in schools, and posters on the subject were universally made use of.

List No. 242, which has just been issued by **Messrs. H. C Slingsby**, the well-known truck specialists, of 71, Gt. Queen Street, W.C.2, will appeal to all manufacturing electricians and central station engineers, as it contains full details and illustrations of the Jacklift trucks, which are manufactured for use in works and factories. These will enable more work to be done with less energy and expense than can in the ordinary way be done by about forty-two times the same amount of manual labour, and, in these days of keen competition, when all charges have to be examined so closely, labour saving devices of this nature are certain to call for prompt and careful inspection.

Sample Pair Sent on Approval for 8/6
Made of Pure Para Rubber, soft and durable and unaffected by climatic conditions
DAVID MOSELEY & SONS,
Limited,
ARDWICK, MANCHESTER.
MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
A PRACTICAL TRADE JOURNAL

SEPTEMBER 12, 1924.

CONTENTS. PAGE

An Interesting Exhibit in the Engineering Building, British Empire Exhibition 479
Telegraphy 481
A New Explosion-proof Transformer 482
Some Notes on Anodes for Electric Galvanising 483
Motor-bus Lighting 484
Current Topics 487
The Post Office Mail Tube 488
Questions and Answers by Practical Men 489
Electrical Engineering—Final Grade 490
Practical Electrical Engineering Hints 493
Mullard Valves 494
Reviews of Books, etc. 494
Answers to Correspondents 495
Various Items 495

AN INTERESTING EXHIBIT IN THE ENGINEERING BUILDING, BRITISH EMPIRE EXHIBITION.

Among the most interesting of the smaller exhibits in the Engineering Building is that of Messrs. Evershed and Vignoles, Ltd., of Acton Lane Works, Chiswick, housed in a showcase to be found in Avenue 14, near the Kelvin Gate.

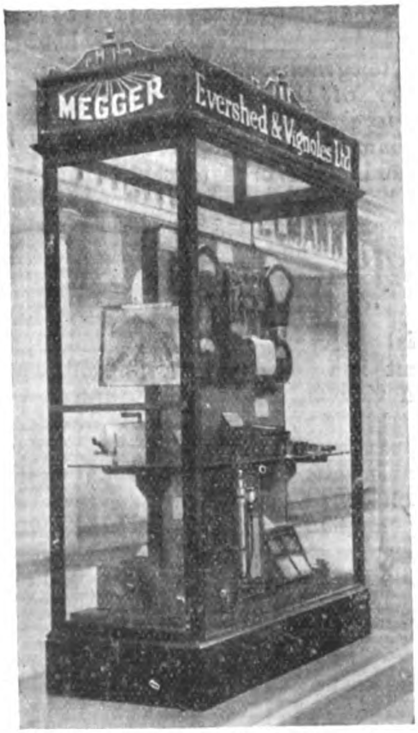


Fig. 1.—Evershed and Vignoles, Ltd., Exhibition Showcase.

This firm has the rather unique characteristic of having confined its activities during 30 years of existence to certain special classes of electrical instruments, and the showcase illustrates very well the latest types in which the company specialise. Evershed and Vignoles, Ltd., have developed the production of instruments for the measurement of resistance, high, medium and low, and now manufacture a complete range of direct-reading ohmmeters, measuring resistance from 1 microhm up to 10,000 megohms. Of these, the higher range instruments are well represented in the Megger and the Bridge Megger sets, both of which are on view, the Bridge Megger being a particularly interesting instrument in that it is used both as a direct-reading ohmmeter for high resistance values, and also for Wheatstone Bridge working, in this way dealing with a very long range of resistance values. The method by which this instrument is changed from Megger to Bridge working is simple and ingenious, the movement of one switch changing over from "Megger" connections to "Bridge" connections, the generator providing the current, while the indicating mechanism functions as the bridge galvanometer.

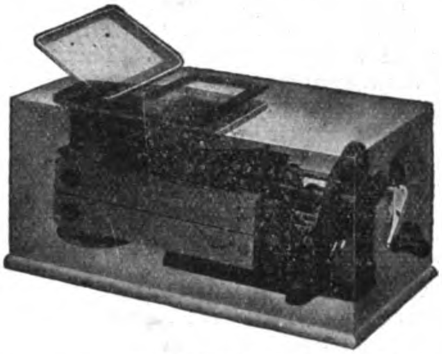
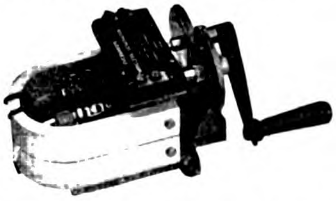


Fig. 2.—"Phantom" View of "Megger" Testing Set.

Meg Insulation Tester.

The most recent development in Evershed and Vignoles resistance measuring instruments is the Meg Insulator Tester, which was introduced two years ago, and has been most successful. While the Megger and Bridge Megger continue to be the standard instruments where the measuring instrument must be capable of dealing with a very long range of resistance values, it was felt that there was room for a smaller, lighter instrument of the Megger type, and having the same grade of workmanship. The Meg, with its range up to 100 megohms, is quite suitable for most classes of insulation testing, and is used very extensively for switchboard wiring, testing generator and motor coils, etc., a rather remarkable fact being that the Meg has had a considerable success in America. Two models are on view, variable pressure and constant pressure, the latter having a speed control device which ensures constant voltage, an important feature where the capacity of the insulation to be tested exceeds .5 microfarad, as, for instance, house wiring insulation, etc.

Fig. 3.—Wireless Generator.



WIRELESS GENERATOR.

The Evershed Wireless Generator, two methods of which are shown, was developed as a result of long experience in the manufacture of small generators for Megger use, the design of the wireless generator being substantially the same as that of the Megger generator, with, however, very important modifications in the construction of the armature with a view to smoothing out the voltage ripple. Theoretically it is impossible for a generator to supply a current with an absolutely uniform voltage, and this would seem to be a very serious drawback in wireless transmission work, particularly in connection with speech transmission. In practice, however, it is quite possible to reduce the "ripple" to such a degree that it is imperceptible, and the Evershed generator has been singularly successful in transmission work, the voltage ripple being so very minute that it cannot be detected in speech transmission if the receiver is over five miles from the transmitter. The generator is much more compact than high-tension batteries, is not subject to the H.T. battery's annoying habit of developing a sudden weakness at inconvenient times, and there are no replacement costs. The hand-driven model develops 1,000 volts at the normal turning speed—100 r.p.m.

This instrument has been in considerable demand for radio society field days, and two of the generators used respectively by the Hounslow and St. Pancras societies were highly successful as the source of supply on a field day held on August 12. The generator used by the St. Pancras society was mounted on a Ford van, and was successful in transmitting speech when the van was travelling over twenty miles an hour, no smoothing devices being required.

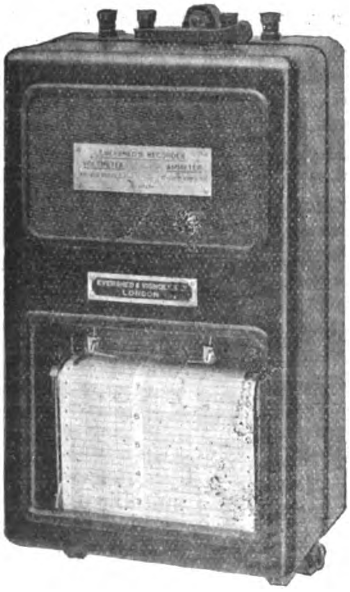


FIG. 4.—RECORDER.

RECORDER.

The company have been interested in production of electrical recording apparatus for many years, the Evershed hot-wire recording instruments having been superseded many years ago by the Murday type of recorder. The instrument exhibited is a combined recording ammeter and voltmeter, and illustrates very well the advantage of the straight hour lines, which are a special feature of the Murday patent and are particularly useful in a combined instrument of this type. It is, of course, much easier to compare simultaneous readings along one straight line than to compare them on the curves of the old-fashioned type of recorder. It is rather interesting to note that recorders are now being constructed for a very great variety of purposes, apart from the customary record of volts, amperes, pressure, etc. Evershed and Vignoles are playing their part in this development, and have recently constructed several recorders for a number of special applications, one with a combined record of current, speed, pressure and operations for a grain-handling machine, another being a recording ammeter with special time and overload warning devices for peak-load operations.

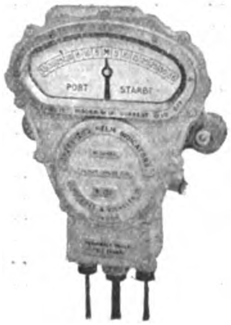


FIG. 5.—HELM INDICATOR.

MARINE ELECTRICAL INSTRUMENTS.

One of their activities which may not be so well known to readers of ELECTRICITY, but has been a speciality of the company since its inception, is the electrical instrument for shipboard use, helm indicators, boiler-room telegraphs, and others of this type. A large number of these instruments are installed in British and foreign naval and commercial vessels, and a new building is now being erected as an extension to the Acton Lane Works to cope with the increased demand. The showcase contains a helm indicator and an electric speed indicator, but there are a number of other marine instruments which were not shown on account of space limitations.

"DIONIC" WATER TESTER.

A special development of electrical resistance measurement has been the "Dionic" water tester, which is on view in the showcase, and is worth more than a casual glance. The "Dionic" water tester has been developed from the principle that a dilute solution has an electrical resistance proportional to the strength of the solution. This principle has been very ingeniously applied in the "Dionic" water tester, which indicates very quickly the percentage of an inorganic impurity in a solution. The "Dionic" water tester has a special field in the testing of boiler feed water, testing leaky condensers, etc., where the amount of impurity is extremely important, and yet ordinary laboratory tests are out of the question. It has also been applied for quite a variety of uses in a great many trades, a recent special application being in connection with the retting of flax.

AMMETERS AND VOLTMETERS.

A number of indicating instruments are shown, including voltmeters and ammeters of the moving coil and moving iron types. These are of the normal E. and V. design, but several of them have unique features of considerable interest to engineers. One of the troubles in the use of a multi-range voltmeter is that the operator is very apt to set the instrument to a range which is altogether too sensitive, the result being that the voltmeter is immediately burned out. The Evershed multi-range voltmeter has an ingenious range switch which makes the votmeter as nearly as possible "fool-proof." This switch can only be moved one step at a time towards the more sensitive ranges, and a lock must be released for each step. As this lock must be turned alternately left and right, it is almost impossible to set the voltmeter accidentally to an ultra-sensitive range. Further, the range-setting handle projects furthest from the instrument at the most sentitive range, and must be pushed in to the least sensitive range before the voltmeter can be packed in its carrying case.

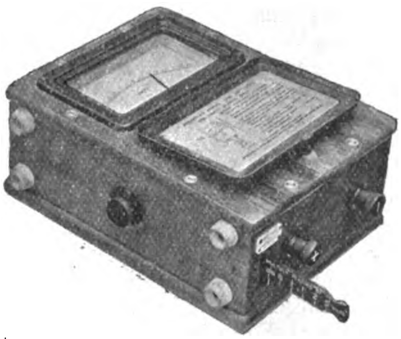


FIG. 6.—MULTI-RANGE VOLTMETER, SHOWING SPECIAL RANGE SWITCH.

Another interesting feature of the indicating instruments is the ammeter shunt. This shunt is of patent construction, the resistance metal being interleaved with the copper in such a way that the shunt can stand almost any amount of overload without permanent damage. Several of these shunts, including one in section, are shown, and they can also be seen on the stand of Henry Wiggin and Co., Ltd., in the Engineering Building.

Enough has been said to indicate that while the Evershed and Vignoles exhibit may be small, it is none the less very interesting. The company have developed the art and science of instrument making to a high degree, and are so convinced of the high quality of their workmanship that an open invitation is issued to all interested in electrical instruments to pay a visit to the factory. This invention is extended to all readers of ELECTRICITY who are *bona fide* users of electrical instruments and are interested in present-day methods of manufacture.

Automatic Telephony.—The Irish Free State Dept. of Posts and Telegraphs has undertaken to introduce the automatic telephone system into the Dublin metropolitan area, and also the suburbs, to a distance of five miles. The complete installation will take five years, but the first section will be in use in one year, viz., in the south-west area.

Irish Hydro-Electric Scheme.—It is understood that the Free State Government have now received the Siemens report upon Shannon water-power development. In this connection we are informed that the promoters of one of the groups interested in Liffey development expect to be in a position to submit proposals of great public interest. Negotiations are, we understand, in progress for the introduction of a new process for the fixation of atmospheric nitrogen and the production of fertilisers upon a large scale.

TELEGRAPHY.*

Being solutions to the questions set at the Grade I. examination in Telegraphy held by the City and Guilds of London Institute on April 30, 1924.

(*Continued from page* 475.)

Q.—Give a diagram of two stations, double-current duplex, without the simplex-duplex switch. Indicate the values of the resistances of the coils of the various instruments employed, and show by means of arrows the directions and relative values of the currents in (*a*) the batteries, (*b*) the compensation circuit, and (*c*) the ine circuit when both keys are depressed.

A.—Fig. 10 shows a diagram of two stations, double-current duplex, without the simplex-duplex switch.

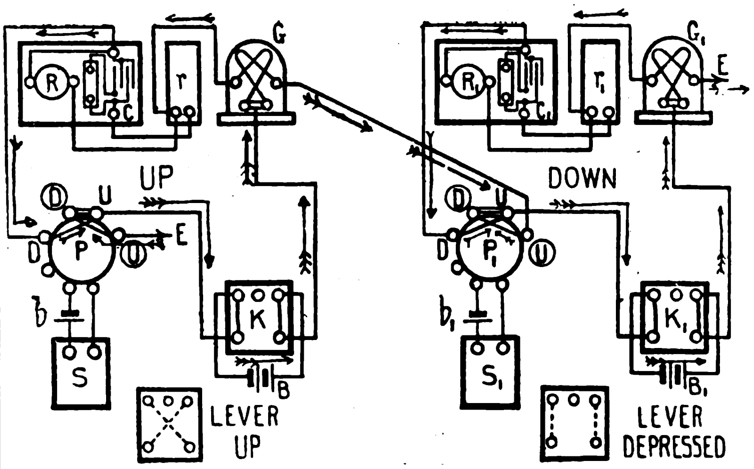


FIG. 10.

G and G_1 are differential galvanometers the coils of which are each of 43 ohms resistance.

P and P_1 are polarised relays the coils of which are each of 100 ohms resistance.

S and S_1 are ordinary sounders, the coils of which have a resistance of 21 ohms shunted by a coil of 420 ohms, giving a joint resistance of 20 ohms.

K and K_1 are double-current signalling keys, both shown "depressed."

B and B_1 are the main batteries, and *b* and b_1 the local batteries.

R and R_1 are rheostats in the compensation circuit at each station, which also comprise the condensers *C* and C_1, and the retardation coils *r* and r_1.

The directions and relative values of the currents in the various parts of the circuit specified when both keys are depressed are indicated on the diagram by the arrows, thus—

An arrow with one feather represents 15 m.a.s.
An arrow with two feathers, 30 m.a.s., and an
Arrow with three feathers, 45 m.a.s.

Accordingly, the current through—

(*a*) the batteries is 45 m.a.s.
(*b*) the compensation circuits is 15 m.a.s.
(*c*) the line circuit is 30 m.a.s.

(*To be continued.*)

---

* Books recommended are:—***Questions and Solutions in Telegraphy and Telephony, Grade I.***, by Few (Rentell, 5s. 10d., post free), and ***The Telegraphists' Guide***, by Bell and Wilson (Rentell, 3s. 10d., post free).

A NEW EXPLOSION-PROOF TRANSFORMER.

A new kind of transformer which eliminates all danger from explosions in power houses has been developed by engineers of the Westinghouse Electric and Manufacturing Co., of Pittsburg. It is known as the "inertaire transformer," and was developed by W. M. Dann and Dr. D. R. Kellogg, associate inventors, and both members of the Westinghouse engineering organisations.

The new transformer is unique in design in that it has a cushion of nitrogen placed above the oil surface in the place of the air that usually occupies this space. The body of nitrogen is automatically created and maintained by the natural "breathing" of the transformer oil. The purpose of the new feature is to secure the decided benefits that are derived from contact with the oil of an inert and protective gas having no oxygen content, and the results obtained are as follows:—Oxidation of the oil is prevented; moisture is excluded from the oil; risk of fire or explosion of inflammable gas above the oil surface is eliminated; and a useful cushion of compressible gas above the oil surface is maintained which is remarkably effective in case of a sudden increase of pressure due to an internal breakdown of the transformer.

Oil is used in a transformer as an insulator, and to smother any arcs that may occur between windings for any cause. Oil expands and contracts according to temperature, and this expanding and contracting causes what is known as "breathing." Thus, when the oil in a container expands, it forces some air out; and similarly, when the oil contracts, air is drawn into the container. This "breathing" action is used in the new type of transformer to form the nitrogen. By an ingenious scheme, the air, being drawn into the transformer due to the breathing action, is made to pass through a quantity of deoxygenating and dehydrating chemicals. In the passage through these chemicals the oxygen content and whatever moisture is present in the air are absorbed, and dry nitrogen is drawn into the gas space.

Transformer oils, like other oils, will oxydise when exposed to air, and their ability to circulate and to dissipate heat is greatly impaired. This oxidation is known as "sludging." The nitrogen blanket, since it prevents air from reaching the transformer oil, likewise prevents it from mixing with oxygen and so "sludging." This is the first great duty of the nitrogen blanket.

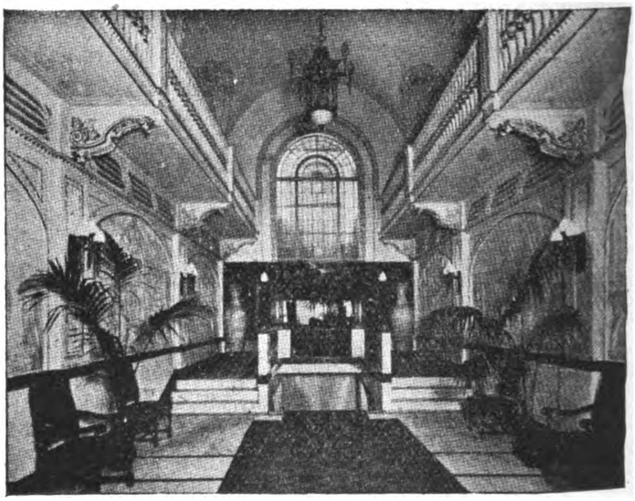
The second is in the prevention of explosions. Arcing between windings, which in the past have occasionally caused disasters due to the fact that explosions took place, are entirely eliminated, due to the nitrogen blanket above the oil which will smother any sort of inflammable occurrence.

The inert gas body above the oil level of the "inertaire" transformer makes explosions in the space impossible. It is always possible that some fault under the oil level may result in an explosion of liberated gases, formed when an electric arc forming under the oil level causes a breakdown in the oil composition. These explosions are not so violent as those which may occur above the oil level, but to prevent them the new transformer has a relief device, which somewhat resembles a manhole cover. The device rests upon the manhole opening in the top of the transformer case. It consists of a circular diaphragm of thin sheet micarta, which is clamped to a support placed directly beneath the manhole cover. The manhole cover itself rests upon the gasketed surface of the diaphragm support, and is free to move upwardly except for its weight and the retarding action of a number of heavy springs. The diaphragm is clamped in position with a ring and a gasket, forming under normal conditions a seal which is gas and oil tight. Thus, if an explosion occurred, the pressure would first rupture the diaphragm and then force the manhole cover open far enough to permit the pressure to escape. Then the springs quickly bring the cover back to its original position, in which it closes the opening. The operation does not permit the discharge of oil or the diffusion of air into the transformer case.

A number of interesting tests were made on the transformer during its development. Perhaps the most interesting was the exploding of as many as twelve 40-gram bombs at a time in the transformer. In all these tests the transformer did not once throw oil, a remarkable feat when the force of the explosion is considered.

AN INTERESTING AUSTRALIAN LIGHTING INSTALLATION.

Herewith we reproduce a photograph of the vestibule of "The Ambassadors," Sydney, Australia, which is at the moment the "wonder restaurant" of that city, and is claimed to be the most up-to-date and elaborately fitted café south of the line. In it Osram lamps are used throughout, and, in addition, most of the important fittings have been supplied by the British General Electric Co., Ltd. For the lighting of the vestibule G.E.C. "Vineyard" and "Kildare" fittings produce well-diffused illumination, which is soft and charming.



MAXIMS.

Men are qualified for civil liberty in exact proportion to their disposition to put moral chains upon their own appetites.—BURKE.

A square jaw doesn't always indicate a powerful mind—sometimes it merely indicates a powerful jaw.

SOME NOTES ON ANODES FOR ELECTRO-GALVANISING.

By SHERARD COWPER-COLES.

Little attention is given to anodes for electro-zincing, although it is one of the most important considerations in practically applying electro-zincing, and many failures are due to want of appreciation of the essential conditions. The chief difficulties are low efficiency, imperfect electrical contact and want of adaptability to the work. That is to say, the anode should follow the contour of the work so as to ensure an even distribution of zinc on the surface of the cathode.

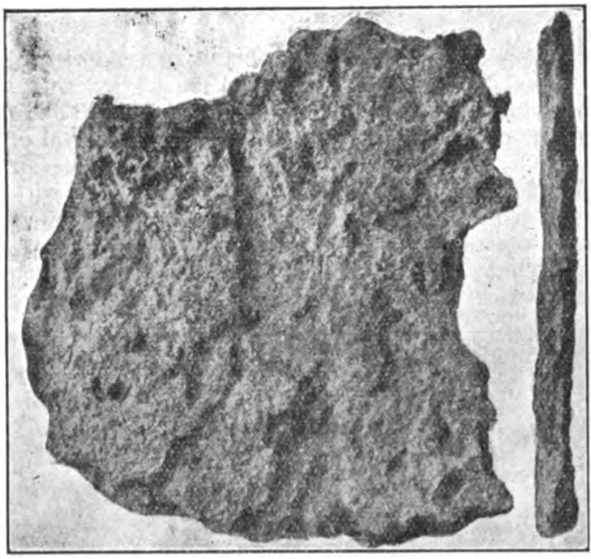


FIG. 1.

An anode for electro-zincing should fulfil the following conditions:—

(1) It should not disintegrate or crumble away.
(2) It should make good electric contact.
(3) It should be readily adaptable to the class or work being electro-zinced.

Unless a high-grade rolled zinc such as Vieille Montagne, which is expensive, is used as anodes, a large percentage of the anode disintegrates and crumbles away. When using cast-zinc anodes, the waste has been found to be as high as 30 per cent. The method of determining is to suspend the anodes in a canvas covering and thus collect the zinc which crumbles away without being dissolved.

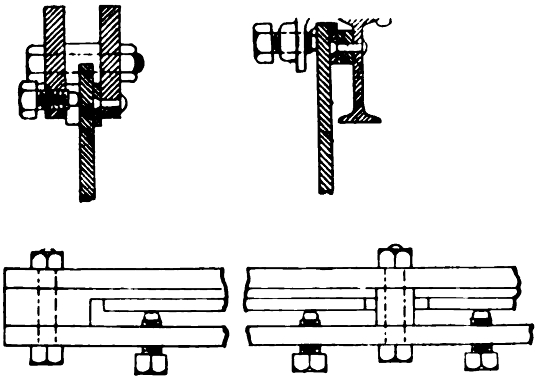


FIG. 2.

Fig. 1 shows a cast-zinc anode, illustrating how it pits and becomes covered with a scale which is not readily soluble in the solution. The scale can be readily seen, averaging nearly one-eighth of the thickness.

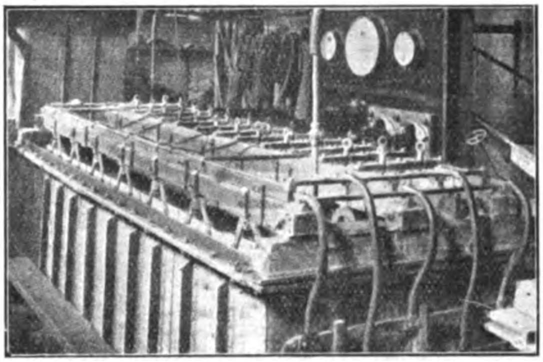


FIG. 3.

The second difficulty referred to, viz., imperfect electrical contact, is often overlooked and is the cause of many failures. The zinc anodes are in many cases suspended in the electrolyte by hooks passed through holes drilled in the top of the anode, quite close to the surface of the electrolyte, which soon become corroded, with the result that some anodes pass more current than others, the cathode current density is uneven, and, consequently, the zinc coating. Zinc anodes should be firmly bolted or screwed to the conductors; a good method is to place a piece of sheet lead between the

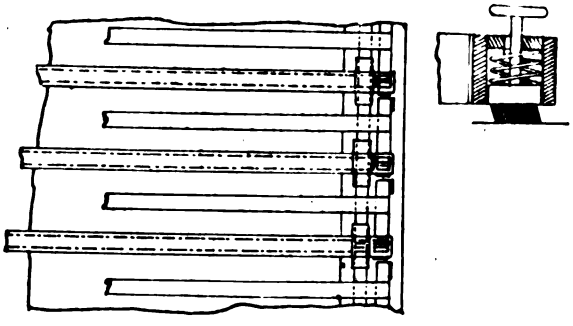


FIG. 4.

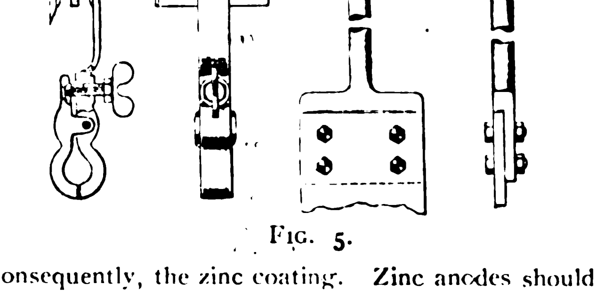
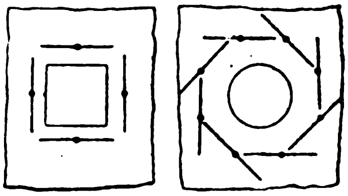


FIG. 5.

zinc and the electrical contact so that it can be screwed up tightly and make a tight joint. Fig. 2 shows such an arrangement. Another common source of bad contact is between the bus bars carrying the anodes and the main conductors. The best method is to have flexible cable, as shown in Fig. 3. Fig. 4 shows an alternative method of a laminated brush contact, but it is not so reliable.



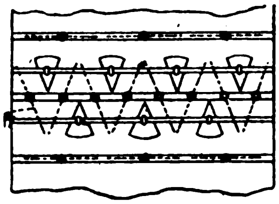


FIG. 6.

The third point is the adaptability of the anodes to suit the various shaped articles that have to be zinced. One method is to have each anode mounted on a single suspension rod, so that it can be turned in any direction and thus be adapted to square or various shaped rectangular articles or tubes, as shown in illustrations Nos. 5 and 6. A second method is to fix the zinc anodes in heavy lead weights, so that they can be placed in any position in the vat, the zinc being insulated from the lead (Fig. 7). A third, and the most practical method, is to employ insoluble sheet lead anodes which can be readily adjusted and bent to almost any shape and portions rendered inactive by attaching pieces of wood with hard-wood dowels. Lead anodes have to be worked in conjunction with the regenerative process for replenishing the zinc as it is deposited, the electrolyte being circulated through a separate tank containing zinc in a fine state of division, such as zinc dust or granulated zinc mixed with coke, which also forms a filter bed keeping the solution in good working order and free from suspended matter. Other forms of insoluble anodes can be used, such as ferro-silicon, but they are not so serviceable, as they are brittle and cannot be bent or adjusted to the work under treatment.

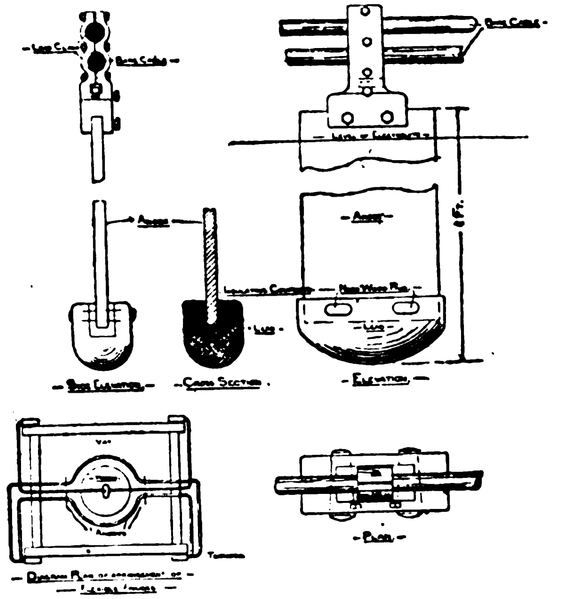
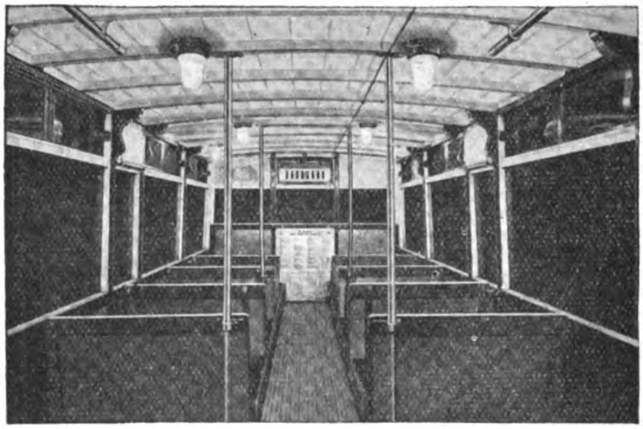


FIG. 7.

MOTOR-'BUS LIGHTING.

The steady advance in the comfort of everyday travel is amply exemplified by the annexed illustration showing the interior of one of the latest of the 300 Tilling 'buses now on the road. Each is fitted with a total of eighteen Osram lamps, of which eight in the interior are special gasfilled omnibus lamps, 12-14 volts, with an energy consumption of 9.6 watts. In this connection it is interesting to note that the current consumption of vacuum lamps previously used was 1 ampere at 12-14 volts, a minimum energy consumption of 12 watts. The use of gasfilled lamps for omnibus lighting, therefore, decreases the energy consumption by at least 20 per cent. This reacts beneficially upon the accumulator, since the discharge rate is decreased. Moreover, a lower discharge rate results in a higher voltage over a certain period of time, and so the illumination is increased.



The head, side and tail lamp units on the exterior of the 'bus are equipped with 12-14 volt, 7-watt lamps, while the destination boards are illuminated with gasfilled lamps similar to those used in the interior.

New Books.—Every electrical engineer to-day is a specialist and needs much information peculiar to his own branch, to meet which Ernest Benn, Ltd., are bringing out immediately the *Electrician* series of Specialists' Data books, under the general editorship of E. B. Wedmore, M.I.E.E., F.Inst.P. The first three volumes will cover: Lighting, traction and power distribution (Vol. I.), manufacture, design and laboratory work (Vol. II.), and telegraph, telephone and radio engineering (Vol. III.). The series is planned so that each volume is self-contained and purchasable separately. Such of the usual tables as are of definite practical value are included, but more than half of the books will consist of specialist data, as yet unpublished in book form, extracted from publications of the Institution of Electrical Engineers and other scientific societies, the publications of large manufacturers, the British and foreign technical Press, the publications of the associations conducting researches in this country and abroad.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N. 17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application, Subscription : 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

Visit Wembley.

Those of my readers who have not yet visited the B.E. Exhibition at Wembley should lose no time in doing so. Already there are signs and portents of the closing date, October 31 (?), and the last few weeks will pass all too quickly. Many thousands of people have doubtless delayed their visit until after the summer (sic) holidays, and there are quite good attendances daily since the beginning of September. It is unlikely that the Exhibition will be repeated next year, and those who forgo their chance of visiting it now will have reason to regret their omission, for there is much to be learnt from an intelligent inspection of the engineering exhibits alone. As a fitting climax to a busy day in the various Exhibition buildings the Military Torchlight Tattoo now being held nightly in the Stadium is an exceptionally fine spectacle, and there are 20,000 free seats, so that no additional expense need be incurred provided one goes early.

It is a curious fact, but provincial visitors seem to be in the majority on most days at the Exhibition, and one hears more of the "Sithee, lad," of Lancashire; the "Yes indeed, whateffer," of Wales; and "We be kum up from Zummerset," than the pure unadulterated Cockney. I suppose the fact of the matter is that Londoners have always some exhibition or another to go to, and even a record show such as that at Wembley merely strikes them as not particularly novel. In any event, there must be a very large percentage of London's seven millions which has never yet journeyed so far as Wembley Park. Not a few of the visitors I have interviewed have admitted that they have only just been once, and weren't at all sure they would be able to come again, although the Exhibition is practically on the Londoner's doorstep. This curious fact is only on a par with the rest of London's "sights," most of which are more familiar to country cousins than to the actual dweller in the Metropolis.

"Life" Tests.

Incidentally, the Exhibition will have provided a number of interesting life tests of mechanisms and devices which have been in more or less constant operation during the six months. Many motors, large and small, driving various machinery at varying loads; switches operated for demonstration purposes many times daily; domestic electric appliances in more or less continual operation or under heat as the case may be, throughout the twelve hours, six days weekly, will have experienced far harder wear and tear than they are ever likely to be called upon to sustain in ordinary use. Then the model devices available for public manipulation: look at the man-handling and abuse they are subjected to from tyros in the matter of operating. There is no doubt that by the end of October some very valuable data should have been compiled by many of the exhibitors on the behaviour under such drastic treatment of some of those exhibits the durability of which is not too well known.

I know of one motor at least which has given up the ghost on a comparatively light and intermittent loading at the end of a modest four months. It is by one of the leading makers and exhibitors too—I will not mention names for obvious reasons—but the fault may not lie with the motor itself but with the conditions under which it has been working. I have also seen a heavy current starter burn out in the presence of an admiring crowd attracted by the smoke to the scene of the breakdown; it is to be hoped that the more observant members of the crowd did not note the maker's name, as these little incidents, although doubtless unavoidable, do not add to the favourable publicity which the Exhibition as a whole is intended to secure for its supporters.

"Top of the Bill."

Electricity has been very much to the fore of late. The World Power Conference has been held, and there the claims and possibilities—particularly as regards transmission and industrial development—were much in evidence. Electricity, of course, has so many paramount qualities that to enumerate and detail these (let alone advertise them) is superfluous; at the same time, as a matter merely of scientific justice, one must admit that gas also has justifiable claims. The two "powers" have much in common, and as each is dependent upon coal there is a vague (but none the less definite) assumption that mutual working may be possible. Closely connected by the link of Wembley is the E.D.A. exhibit at the British Empire Exhibition, and though one feels that this in some respects might have been more impressive, and even *personal*, it is a fine and thorough display of electricity in service. There is a sudden awakening or added interest in wireless by the historical announcement of economical long-distance "beam" transmission, while the proximity of Mars has aroused fresh interest in this friendly planet, and wireless "touch" is being attempted.

Then there is the report of Mr. Lloyd George's Committee, with its lively (though belated and by no means novel) suggestion for great schemes of electrification, followed by the announcement, on the part of the Chancellor of the Exchequer, of Governmental interest in the encouragement and broader adoption of electricity. Mr. Snowden has been accused of stealing Mr. Lloyd George's stage thunder (*lightning* would be a more apt word!). This surely need not necessarily be so. One would have to be particularly purblind to leave electricity out of national development plans. And so, rather suddenly and, it would seem, bewilderingly, the "unseen fluid" is being recognised for the mighty and formidable agent it is. In such manner did the potentialities of the British Empire Exhibition dawn upon the public. We must not, however, overreach ourselves in enthusiastic "boosting" of electricity. Some of the lamentable mistakes of the wireless trade must be avoided at all costs. Let what is advertised and sold be efficient and—*used*. Practical optimism: optimistic practice.

Those Wireless Wizards.

I really ought not to neglect mention of that tireless section of the community whose researches in wireless receive such ready and gratis publicity in the daily Press. It is, you know, *most* convenient to do your wonderful and awesome experiments without the aid of wires. It costs a lot less, and if you are playing (or pretending to play) with an unseen force, especially "wireless"—why, look at the tremendous possibilities! People are very gullible, more gullible, over anything of this nature. I've come to the conclusion that in these matters the most gullible and inept and trustful individual of all is—"our local correspondent." Tell him that you are a wireless expert: that's your first blow in. Show him a maze of wires (it's wireless, remember), a couple of valves, a honeycomb coil and a big condenser: this gets him on the solar plexus. A few technical terms are as good as an upper-cut. Then tell him that you are sending energy five miles without wires, and at the other end killing rabbits or lighting a house, and he's down for the count and you're safe for a half-a-column to-morrow morning. *He* won't go five miles to verify. You may be sure of that. For "our local correspondent's" energy is all needed for pushing his pencil—there's none left in his head (no time to *think*), and precious little in his feet for a five mile tramp. If you are a death ray inventor *be very careful*. No, no! Not of your ray, for you seem to go remarkably scot-free, and even the cockroach under the mat doesn't feel a twinge. No, not that. *Be very careful of the technical Press*, and *mind you dodge the technical men!*

Argentine.

In the July issue of the monthly journal of the British Chamber of Commerce in the Argentine Republic there is an interesting account of a farewell luncheon given to Mr. Harry Scott on his retirement from the management of the office in Buenos Aires of the bank of London and South America, prior to his departure for England. It was attended by a very large number of the leading members of the British trading and professional community, and I noticed with interest that one of those present was Mr. D. H. Nye, of the Anglo-Argentine G. E. Co., Ltd. Mr. Nye must now be quite a veteran in the life of the English colony in that great South American city, because in a book entitled "From the Beginning," which was published in the 'nineties, and dealt with the early history of the well-known Robertson lamp, I find his portrait on page 84 as being the representative of the G.E.C. in Buenos Aires at that time, along with the photo of Mr. J. Y. Fletcher, now a director of the G.E.C. and at that time representing the company in Dublin. It is wonderful how time flies and what changes it brings in its train.

Outside Support.

I notice with interest and pleasure that electricity central stations, and for the matter of that the gas companies, are receiving support from at least one important advertiser in London who is evidently anxious to increase the demand for light in newly decorated houses. The advertisement is displayed in many of the tube stations, and is a decidedly attractive representation of the process of repapering a room with a pattern of wall paper which is calculated to absorb the greatest possible amount of artificial light. From the point of view of helping the demand for current or gas, it is an A1 pattern, but I should much like to hear the views of Mr. Gaster, Mr. Guy Campbell, or other illumination experts. I have consulted text books on the subject and they seem to show a loss of approximately fifty per cent. in reflection efficiency. When a room is being repapered that is a very important consideration.

ELEKTRON.

THE POST OFFICE MAIL TUBE.

The English Electric Co. have secured from the Postmaster-General the contract for the rolling stock and complete electrification of the Post Office tube railway.

It will be recalled that the purpose of this tube railway, which is really a reconstruction and extension of the old mail tube built by the postal authorities over 50 years ago, and illustrated and described in Routledge's Discoveries and Inventions of the Nineteenth Century in 1879, is to facilitate the rapid handling of parcels and mails in the London area by providing direct underground communication between some of the chief railway termini and the principal postal distributing centres.

The scheme of operation is quite unique. The trains are manless, carrying neither driver nor conductor, but the system of control provides for an automatic safeguard against collision, and they will proceed between pre-arranged points, braking and stopping at the appointed place, just as though they were being directed from the train itself, and, in fact, apparently thinking for themselves.

The whole of the design and development has been done by British engineers, and the equipment will be made at the English Electric Co.'s traction works at Preston, better known as the Dick Kerr traction works.

Wireless Trade Opportunities.—A confidential report on the market for wireless apparatus in Australia has been prepared by the D.O.T., also on wireless apparatus in the Munich district of Germany, and U.K. firms desirous of receiving copies, together with full particulars of the Special Register service and form of application for registration, should communicate with the D.O.T., 35, Old Queen St., London, S.W.1.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.

ANSWERS: A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed a the top left-hand corner of all letters intended for this column.

QUESTION NO. 188.

I have under my charge a large number of mercury motor-meters for overhauling and calibration. I would like some details as to how I can clean mercury with acid and subsequently distill it in vacuo. Any other method of purifying mercury will be helpful. I have been sending the mercury to Johannesburg to a chemist, but I wish to do the cleaning myself.—JOHN J. WUD, Witenhage, C.P. South Africa.

QUESTION NO. 189.

Can you give me a reliable method of adjusting the ordinary microphone transmitter (carbon) fitted to magneto ringing telephones fitted with induction coils in a private exchange?—"MAGNETO."

(Replies to Questions Nos. 188 and 189 must be received not later than September 27, 1924.)

Answers to Questions.

QUESTION NO. 182.

The second prize (5s.) has been awarded to "E. M. F." for the following reply:—

A. N. Butters' question opens up a wide field which would require a goodly proportioned pamphlet to be answered in full, especially as he does not tell us whether the motor is shunt, series, or compound wound, or whether it stops whilst running, or fails to start.

In my experience most of the faults which have no immediately apparent cause are first observed by reason of the motor failing to start, and faults in this category will be dealt with first.

For the preliminary tests a most useful appliance comprises two 230-volt carbon filament lamps, wired in series at the end of a pair of flexible leads, say, two or three feet long, which we will term a test lamp.

(1) *Failure of supply.*

When a motor fails to start the first thing is to ascertain whether the current is available. Put the ends of the test lamp leads across the incoming terminals of the double-pole switch controlling the motor. If the supply is available the lamps will light. If it is not, the lamps will not light, and the remedy is to examine all fuses between the switch and the source of supply, or if a similar test indicates no supply at the source, to communicate with the generating authority.

(2) *Open circuit.*

If the test described in (1) proves the supply to be available the next thing is to search for an open circuit, which may be anywhere between the starting switch and the commutator, and the following tests should be carried out in the sequence in which they are given.

Close the double-pole switch and leave the starter at "off." Connect one end of the test lead to a normally live metal on the starter arm, and the other end to the first stud. A full light on the lamps indicates a complete circuit through motor and starter. No light indicates a broken circuit, and the test should then be applied to each successive stud. If a full light is obtained with the lead on an intermediate or final stud, there is a broken circuit in the starter, and the remedy is to take it adrift and repair the damaged conductor, which will doubtless be found by inspection.

When carrying out this test in conjunction with a shunt or compound wound motor, it may be found that the lamp filaments only attain a dull red condition, or maybe nothing but a spark will be observed when "flicking" the lamp leads to the various terminals. This indicates a sound shunt field circuit, but an open circuited armature, the comparatively high resistance of the shunt field accounting for the absence of full light on the lamps.

The principle of the foregoing test is that as soon as the lamps bridge the broken conductor a light is obtained via the sound portion of the circuit. If the starter appears to be sound, put the handle in the "full on" position and apply the test leads to the motor terminals. A light on the lamp indicates everything correct up to the motor terminals. No light indicates a broken conductor between starting panel and motor terminals, and this may then be closely located by "ringing through" with a bell and battery. If the motor has only two sets of brushes, and maybe only one, or perhaps two, carbon brushes per set, it is possible for the brushes to become wedged in their holders, especially if the holders are of the box type. The result is that the brushes eventually fail to make contact with the commutator.

The fault may be detected by connecting one lead of the test lamp to, say, the positive brush holder and the other lead to the commutor close to the negative brush holder, the starter being at "full on."

No light indicates brushes failing to make contact, and the remedy is obvious.

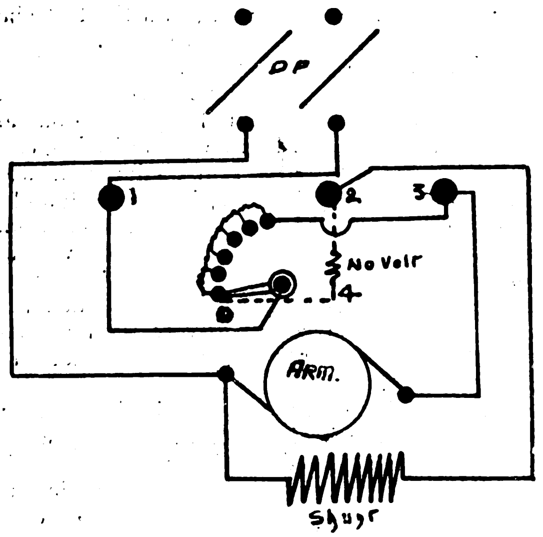
This is a fairly common fault with some makes of machine, and seems to be due to the swelling either of the brush-holder boxes of the carbon brushes, or both when hot.

Nevertheless, when the brushes are eased, care must be taken to see that they are not made to fit too loosely or sparking will result.

If the motor is series wound the field circuit may be open-circuited, in which case the motor would fail to start. This fault may quickly be detected with the test lamp by closing the switch, putting the starter to "full on" and bridging the field winding of the motor with the test lamp. A light indicates a broken field circuit Such a fault is a somewhat remote contingency for a 20-h.p. motor, because the field conductors must of necessity have a comparatively large sectional area, and therefore considerable mechanical strength.

The foregoing are the least apparent of the faults which may arise in practice, because they do not operate the overload protective devices; but there are others which, whilst they will most likely cause the overload devices to operate, do not usually exhibit any visual peculiarities by which they can be located.

(3) *Shunt Motor with Open-Circuited Field.*—This condition will cause the fuses to blow, and can be detected by connecting the test lamps across terminals 1 and 2 of the starter (see the accompanying sketch) with the cable disconnected from terminal 3.



If the field circuit is sound, either a dull glow will be obtained on the lamps, or, if the field resistance is too high to permit the lamps to glow, a spark will be obtained when the leads are "flicked" on the terminals. No spark or glow indicates a broken field. If this test proves the field circuit to be continuous, a similar test should be carried out between 1 and 4 to ascertain whether the no-volt coil on the starter is sound, for it must not be forgotten that the no-volt coil is usually in series with the field winding of the motor.

Similar tests would be carried out to locate an open-circuited shunt field on a compound-wound motor and its starter.

It was stated earlier that the test lamp should consist of two 230-volt lamps connected in series. This was on the assumption that the line voltage would be round about 460; if the voltage is higher or lower, lamps to correspond should be used, and it will be clear that up to 250 volts only one lamp is necessary.

The tests described are purely preliminary, but with a little experience of these methods it is possible to locate a large variety of faults in minimum time.

Faults which are usually obvious at first inspection, such as burnt-out armatures and commutators, are not treated.

If the foregoing tests do not disclose the reason for the failure, one should next look for an "earth" or short circuit. This is best done with a "megger," and, of course, the D.P. switch must be open during such a test.

The test should first be made across the load side of the D.P. switch. If an insulation fault is indicated, disconnect all cables, and test each conductor and each circuit in motor and starter separately until the faulty one is discovered.—" E. M. F."

ELECTRICAL ENGINEERING.—FINAL GRADE*.

Solutions to Questions set at the 1924 Examination of City and Guilds Institute.

BY EDWARD HUGHES, B.Sc., A.M.I.E.E.

(*Continued from page* 476.)

Q. 4.—What is meant by a "surge" in a transmission line? Explain how surges may arise due to the sudden interruption of a short-circuit.

A. 4.—A "surge" is defined by the British Electrotechnical Committee as "an abnormal rush of current along a conductor." Thus, suppose a static charge to be induced in an overhead line by a neighbouring charged cloud. When the latter discharges, the charge on the line spreads outwards along the line, travelling in each direction at the speed of light.

Let us consider the sudden interruption of a short-circuit at X by switch S (Fig. 3). Suppose L to be the inductance in henries of the machine or apparatus supplying the power, and C the capacity in farads between the two conductors of the transmission line. If i be the instantaneous value of the current ruptured by S, the electromagnetic energy stored in L at that instant is $\frac{1}{2} L i^2$ joules. If the resistance of the circuit and the energy lost in any sparking at the switch be neglected, all the energy stored in L will be transferred to C, charging the latter to a potential v, such that

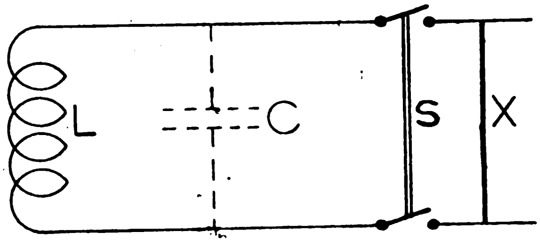


FIG. 3.

$$\tfrac{1}{2} C v^2 = \tfrac{1}{2} L i^2$$

$$\therefore v = i\sqrt{\frac{L}{C}}$$

Hence, if either the circuit i or the ratio $\frac{L}{C}$ or both be large, the voltage v across the dielectric may reach a very high value. Further, $L\,C$ forms an oscillatory circuit, the energy initially stored in L simply oscillating between L and C. At one moment the current is zero, but the P.D. across C is then a maximum; at another moment the P.D. is zero, but the current flowing round the circuit is a maximum. The magnitude of the oscillating energy decreases at a rate depending upon the losses in the circuit.

(*To be continued.*)

Wanted.—Can any reader furnish us with a technical description of the Klydo Electric Sign? We have been asked for installation details by several of our readers, and we are always anxious to oblige with technical information of this nature if it is possible for us to do so.

---

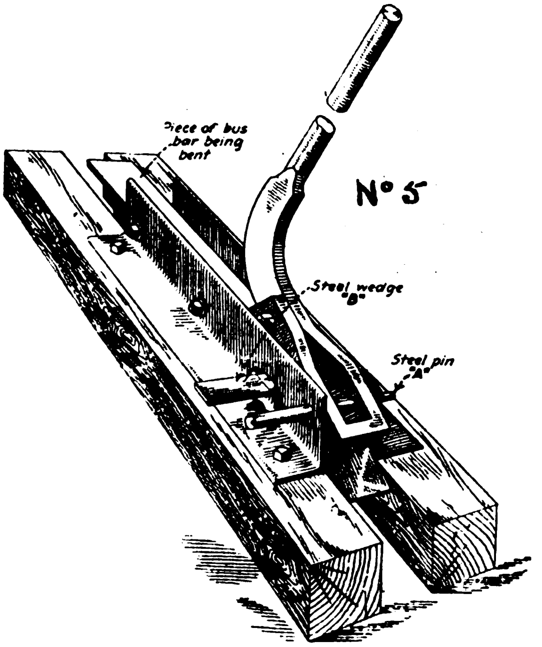
* Books recommended are *Continuous Current Electrical Engineering* and *Alternating Current Electrical Engineering*, both by Maccall (each 15s. 6d., post free), and *Alternating Current Electrical Engineering*, by Kemp (17s. 6d., post free), from S. Rentell and Co., Ltd., 36, Maiden Lane, London, W.C.2.

Practical Electrical Engineering Hints.

We cordially invite all our readers to contribute to this interesting and useful feature. All hints received will be given careful consideration and will be paid for at our usual rates.—THE EDITOR.

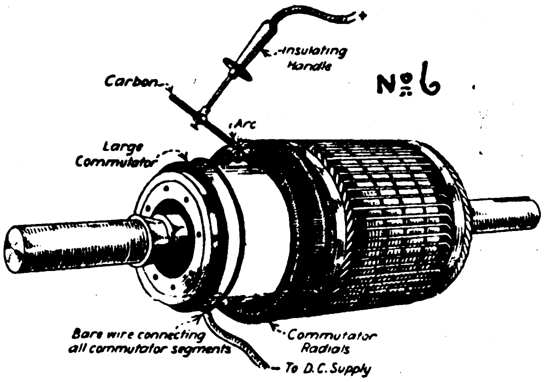
No. 5.—HOW TO CONSTRUCT A BENDER FOR BUS-BAR WORK.

It is some time since we had a big job in the North of England which necessitated the bending of a large quantity of copper bars for bus-bars. Warming the copper and hammering it in a vice was a tedious job, so we adopted the arrangement shown in the sketch. Two pieces of angle-iron were obtained and mounted upon two pieces of wood. Bolts and nuts acting as distance pieces also provided a rest for the bar to be bent; a steel wedge B held the bar firmly in position. The bending lever is pivoted on the steel pin A, and by exerting a downward pressure upon the handle any degree of bend could be obtained.—E. ELWOOD.



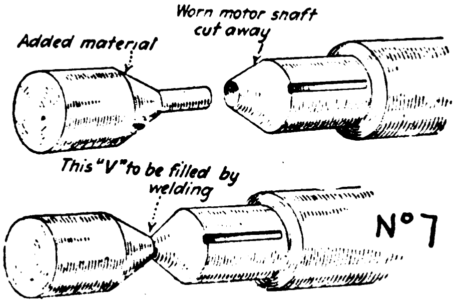
No. 6.—HOW LARGE COMMUTATORS CAN BE SOLDERED WITH AN ELECTRIC ARC.

The difficulties of applying large soldering irons to large commutators is well known; they are inconvenient to heat, handle and apply to the connections to be soldered. An arrangement we used to overcome the difficulty of large irons is shown in the sketch. An arc of approximately 5 amperes at 125 volts direct current is obtained and applied to the point where the armature coils are to be soldered to the commutator segments. One end of the supply is connected to the commutator by winding the bare wire round the whole of the commutator segments; the other end of the supply is connected to an arc lamp carbon held in a holder insulated with a wooden handle. When an arc is struck the solder is fed into the joint, when it will be found to run freely.—A. J. S.

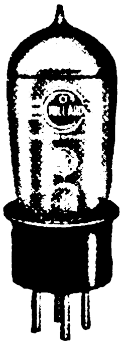


No. 7.—HOW A WORN MOTOR SHAFT WAS WELDED AND MADE GOOD INSTEAD OF BEING SCRAPPED.

In our foundry the great variation in load, and the tendency of a lift attendant to cut the resistance out of the lift motor circuit too rapidly, caused the keyway in the motor shaft to wear so badly that it was thought that a new shaft was necessary. We had not a spare motor to replace this one and we could ill afford to shut the motor down for any length of time. I decided to try welding, just filling the keyway and machining a new one. This was not satisfactory. Then I turned off the end of the shaft and drilled a hole in the end, as shown in the sketch, and then turned up a piece of material with a pin on the end, to enter the hole in the shaft. I then arc welded material in the V until it was quite full, and afterwards placed the armature in the lathe and turned it down. A keyway was then cut in the welded and new material and was found to be satisfactory. This was due to the fact that the key did not depend upon the welded material for support alone, since it was embraced by the old material and the new material on the end of the shaft.—A. B. JONES.



MULLARD VALVES.



The Mullard Radio Valve Co., the well-known makers of high-class valves for wireless purposes, have recently produced two valves with special characteristics which render them of particular interest to all users who desire to get the very best results, on bases of more definite calculation, than are often procurable when purchasing what are called "general purpose" valves. It is obvious that the principles which govern efficiency in L.F. amplification cannot be the same as those needed for H.F. or for detection and rectification, yet a general purpose valve is so designed that in order to make it applicable for all three purposes certain details have to be modified, and in sacrificing a feature which means perfection in the one case in order to meet the need of the other the capability of getting the best results is considerably interfered with and impaired. To obviate the disadvantages, the Mullard Valve Co. make these two valves specially, in which all the details are worked out and applied, so that the L.F. valve is especially and altogether designed in every feature to give its utmost value in low-frequency amplification alone, and should not be used for H.F. or detector purposes. In like manner, the H.F. valve is similarly designed for high-frequency amplification and not for L.F., but the same principles being suitable for detection, this valve also makes a perfect detector.

We have been able to test these valves and have noted the very distinct advantage to be gained, both in volume and in tone, while the range of adjustment is also very marked. In this connection we found it desirable to use a separate H.T. battery for each valve. This enabled the volume of signal reception to be very closely gauged and adjusted to most favourable results.

We were particularly pleased with the L.F. amplifier in combination with a crystal, the result being, in our estimation, strikingly superior to ordinary experience.

There are also certain features in the construction of the valves which are noticeable as improvements. There is no metal shrouding to the cap, which is composed of insulating material entirely, in which the four contact pins are imbedded. Any capacity weakness is thereby reduced, if not entirely eliminated. The filament is also crescent shaped and is not under "tension," and cannot sag so as to foul the grid, while the grid is so constructed that the centre portion encloses the filament more completely than the end portions, which is a feature also conducing to efficiency. Then the plate or anode is "U" shaped and ribbed to ensure rigidity, and the supports are exceptionally strong and stiff, so that displacement or vibration is next to impossible.

The valves are very neat and attractive in appearance, and the method of packing and the stout boxes in which the valves are enclosed for transport, with very plain directions as to opening and handling, should give additional confidence to would-be purchasers living at a distance.

After the first baby arrives a marriage is likely to be a howling success.

Are you bigger than the man you dislike, or merely is your hate bigger?

Reviews of Books, &c.

[Books noticed in this column will be sent from ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

THE ELECTRICIAN ANNUAL TABLES OF ELECTRICITY UNDERTAKINGS, 1924. 151 pp. (Benn Bros., 10s. 6d. post free.)—The thirty-seventh edition of these invaluable tables fully maintains the high standard of excellence which has characterised them during so many years. The advantages of the new form of presenting the statistical information, adopted in the 1921 issue, becomes more apparent in each succeeding issue, there being no difficulty in adding further information as occasion arises, without the crowding inevitably associated with the old tabular arrangement. As the years go on it becomes more difficult, but fortunately less necessary, to speak in fresh terms of the utility of the tables. Covering, as they do, all the leading particulars concerning the equipment, system and supply rates of British, Colonial and many foreign electricity undertakings, they are of the highest possible value to the electrical industry. Particulars are given of the oil-burning apparatus employed by a number of undertakings, and the information regarding mains and distributors, converting plant, showrooms, etc., which has been inserted in the present edition, undoubtedly adds materially to the value of the tables.

The British Engineering Standards Association has recently issued five specifications for different grades of raw copper, namely, No. 199—1924, electrolytic copper ingots and ingot bars; No. 200—1924, tough copper cakes and billets for rolling; No. 201—1924, fine copper cakes for rolling; No. 202—1924, electrolytic cathode copper; and No. 203—1924, "best-select" copper. A sixth specification, covering electrolytic copper wire bars, cakes, slabs and billets, will be published shortly.

The specifications have been drawn up with extreme care, and after prolonged study, on the one hand, of the requirements of the various users of copper, their standards of desirable material, etc., and, on the other hand, of the actual and possible standards of purity of the various coppers now being marketed by producers. The aim has been to make the specifications sufficiently exacting to maintain and improve the quality of raw material already being supplied to high purities, and at the same time to leave them elastic enough for ordinary metal market use. It is hoped that both buyers and sellers, makers and users of copper will find them of great assistance in all contracts, affording as they do an exact scientific basis for market transactions.

Copies of the specifications may be obtained from the B.E.S.A. Publications Department, 28, Victoria Street, S.W.1, price 1s. 2d. each post free; or from S. Rentell and Co., Ltd., 36, Maiden Lane, London, W.C.2.

THE ORIGINAL BOOK OF THE FORD, 9th edition (Temple Press; 2s. 6d. net.)—The recently issued eighth edition of this popular handbook having sold out rapidly and now being out of print, a new and ninth edition has just been introduced. As there have been various changes made in the English Ford model since the last edition was introduced, the book has been revised by the author to bring it right up to date, and a considerable amount of new text and a number of new illustrations have been added. It is the most comprehensive and practical book on the driving and management of the Ford car obtainable, written in an interesting non-technical style, fully illustrated, and contains everything that the owner or driver of a Ford car or van should know.

BRITISH STANDARD LIMITS AND FITS FOR ENGINEERING: B.E.S.A. PUBLICATION NO. 164-1924. (1s. 2d. net post free.)—No doubt very many engineers are aware that a committee of the British Engineering Standards Association has had under consideration for some considerable time the question of limits and fits for cylindrical work, and a successful conclusion has now been reached by the issue of this new publication.

The first section includes a brief statement regarding the adoption of the hole basis as the British Standard, definitions of the unilateral and bilateral systems of tolerance, and the reasons which have led the committee to recommed the use of the unilateral system as applied to cylindrical mating surfaces in cases where it does not conflict with predominating present practice. This is followed by explanatory notes and general directions for using the tables of British Standard tolerances for both unilateral and bilateral holes, for shafts and for the fits obtained by the mating of the shafts with certain of the holes. The report concludes with diagrams giving a graphical representation of the various tolerances and fits. A noteworthy feature of this publication, and one which is likely to prove exceedingly useful to engineers, is the adoption of a single series of shafts for use with both the unilateral and bilateral holes, which will give all the fits generally required. Separate tables and diagrams are included for inch and metric units.

A wall chart (Publication No. 164 B-1924), giving the tables and diagrams in inch units, with explanatory notes, has also been issued.

Copies of these Publications (Nos. 164-1924 and 164 B-1924) may be obtained from the B.E.S.A. Publication Dept., 28, Victoria Street, London, S.W.1, price 1s. 2d. each post free, and also from the office of this paper.

WHERE TO SEEK FOR SCIENTIFIC FACTS. By Alec B. Eason, A.M.I.C.E. (S. Rentell and Co., 1s. net).—This, again, is a most useful reference booklet, the avowed objects of which are to indicate lists of books on various science subjects; books, or journals and proceedings, transactions and bulletins of learned and scientific societies; indexes of literature and publications and papers on technical and scientific subjects; abstracts of technical papers, etc. All these and more this little booklet accomplishes in a most efficient and time-saving fashion. It should prove invaluable to the business man or student and engineer, who invariably require such a vade-mecum on occasion.

Answers to Correspondents.

D. WILLIAMS (Pontllanfraith, Mon.).—Your question has been placed to be dealt with in our Questions and Answers Competition. In this way you will receive the benefit of the experience of our readers.

SOUND TRADE MAXIMS.

(1) Teach your boys one or more foreign languages, but teach them at an early age and thoroughly.

(2) Send your young men abroad for study and for commercial training.

(3) Study the requirements of foreign markets and make your goods to suit them.

(4) Employ British travellers speaking your prospective customer's language in preference to soliciting by post.

(5) Quote your customers in the weights and measures and currency of their country.

(6) Quote for your goods delivered at your customer's door. Shipping agents will invariably quote free delivery, duty and all charges prepaid.

(7) Your catalogues should be printed in your customer's language.

(8) Endeavour to meet your customer's requirements from the point of view of credit.

(9) Correspond with your customers in their own language, not in your own.

(10) Help to maintain the high standard of British commercial integrity.

(11) Make use, through your travellers and by correspondence, of our Commercial Attachés and Consuls, and also British Chambers of Commerce abroad, who are able to help your business in very many ways.

Various Items.

Belfast.—The Council have obtained a cheque for £150,000 from the Imperial Government in full and final settlement of the Corporation's claims in respect of the cost of extension of the Belfast Harbour electricity station.

Coleraine (Co. Derry).—At the Urban Council on the 1st inst. it was decided to send a circular letter to the gas consumers to ascertain whether or not they would be willing to install electric light in the event of the proposed electricity scheme being proceeded with.

Switchgear at Olympia.—We understand that over fifty Brookhirst motor-starting panels have been selected by various exhibitors to control the plant which they are showing at the Machine Tool and Engineering Exhibition now open at Olympia. This exhibition is being referred to in a separate column, and it is one which our readers should make a point of visiting at the earliest possible date.

Tenders Accepted.—The Southern Ry. Co. has accepted the tender of the Siemens and English Electric Lamp Co. for the supply of incandescent electric lamps for six months from September 1. Also the G.P.O. has placed a contract with them for the supply of Siemens vacuum and gas-filled type lamps for the twelve months ending August 31, 1925. Their tender has also been accepted by H.M. Office of Works for the 12 months' supply of Siemens vacuum type lamps.

India.—In the Government report on the import trade of India during the three months from April 1 to June 30, we notice that there has been a heavy drop in the shipment of electrical goods from Great Britain from 63 to 31 lakhs, whereas those from Germany rose from 4 to 5 lakhs, Italy from one lakh to two lakhs, and the U.S. from 3½ to 4¼ lakhs. The principal reductions in the British share were in cables and telegraph and telephone apparatus. Let us hope that the subsequent nine months will tell a very different tale.

Engineering Conference at Wembley.—In connection with the Conference of Engineering Societies, convened by the Society of Engineers at the British Empire Exhibition, on Monday, September 15, 1924, at 10.30 a.m., in addition to the attractions already announced, we learn that Mr. Yorath Lewis, M.I.Mech.E., will give a short lecture at the Conference on the Never Stop Railway. Applications for tickets, including admission, lunch and tea, price 5s. 6d., should be sent at once to the Secretary of the Society of Engineers, 17, Victoria Street, S.W.1.

Wanted: Small Water-Wheels.—The Power Commissioner, Manitoba Power Commission at Winnipeg, will be glad to receive particulars from British manufacturers of small water-wheels. Further information may be obtained from the D.O.T., 35, Old Queen St., London, S.W.1, quoting reference A.X. 1284.

South Africa.—The August issue of our esteemed contemporary, the *South African Power Engineer,* contains interesting illustrations, and descriptive matter dealing with the new Witbank Power Station on the Transvaal, in which five 20,000 k.w. generators are to be installed. Another article deals with Transvaal industries and cheap power, and has a review of the possibilities of the new power station for the promotion of new industries.

E.D.A. Films.—Three new cinema films which have been produced by the Electrical Development Association are being exhibited in H.M. Government Pavilion at the British Empire Exhibition. Titles and times are as follows, viz.: "The History of Electricity," every Friday, between 5.30 p.m. and 6.15 p.m.; "The Perfect Servant Who Rules the World," every Wednesday, between 11 a.m. and 12 noon; and "A Visit to an Electrical Farm," every Monday, between 12.45 p.m. and 1.45 p.m. Everyone interested in electricity and its application to the tasks of everyday life should see these films.

Quotations Wanted.—The New Plymouth, N.Z., Harbour Board are inviting tenders for the supply and delivery of three electric capstans and six fairleads. The N.S.W. Govt. Rys. and Tramways are calling for tenders for the supply, delivery and erection of two battery-charging motor generators. Also for the supply, delivery and erection of two electric storage batteries for signal operating.——The Direction de l'Intendance de la Direction Générale (Postes et Télégraphes) at Constantinople invite tenders for the supply of 100 large and 500 small voltmeters. Specifications, etc., from the D.O.T., 35, Old Queen St., London, S.W.1.

Transport Conference.—The Institution of Transport will hold a conference at the British Empire Exhibition on September 19 at 10.15 a.m. Members will assemble in the pavilion of the Port of London Authority at eastern end, Avenue 5, of the Palace of Engineering. From 10.15 to 10.30 a film depicting some of the activities of the Port will be shown in the Authority's cinema theatre adjoining. At 10.30 a.m. there will be a conference in the cinema theatre, followed at 1.45 p.m. by luncheon at the Regent Restaurant, at which Sir Henry Maybury will occupy the chair, after which visits will be made to the Motor vehicle, Railway and Water Transport exhibits in the Palace of Engineering.

Motor Ships.—The September issue of the *Motor Ship* contains various articles which will be of direct interest to electrical engineers, including an article on page 189, dealing with the "Evolution of Electrically Driven Auxiliaries." On page 195 is a reference to the 300-ton motor yacht "Endymion," in which the auxiliary machinery, including the windlass, is operated electrically, and on page 204 details are given of similar machinery in the engine-room of the motor tanker "British Aviator," the plant for which was supplied by the Metropolitan Vickers Co. Finally, on page 218, there is an excellent description of Mr. F. W. Vanderbilt's new 640-ton motor yacht "Vedette," which has a first-class electric lighting installation.

South Africa.—We have received from the Publishing Department of the South African Railways and Harbours at Johannesburg, through the High Commissioner in London, a copy of a well-printed and beautifully illustrated quarto book of some 158 pp., giving comprehensive details of the railways and harbours of the Union of South Africa as now established, together with a resumé of their progress from the early days to the present time. It should help manufacturers and merchants in this country to gain some idea of the enormous possibilities of trade which are opening up steadily in this great Southern state, and we hope that full advantage will be taken of it to push English goods to the utmost possible extent. References are given therein to the electrification of the main line sections in certain parts of the Union, and this will, of course, appeal directly to all electrical engineers.

Perhaps the most annoying thing about work is the sight of a man who can get along without it.

The reason the speeches come after the dinner is because nobody could listen to them before dinner.

Turn your good ear to praise, your deaf ear to scandal.

Trade Notes.

The Cambridge Instrument Co., Ltd., of 45, Grosvenor Place, S.W.1, are issuing a card giving illustrations and details of their Cambridge Simple Drum Camera, which has been designed for recording tests made in the laboratory and workshop. The card will be willingly sent to any reader on application.

A new catalogue of domestic electrical appliances has just been published by the **Sun Electrical Co., Ltd.**, of 120, Charing Cross Road, London, W.C.2. It covers a complete range of the appliances shown by experience to be of service in domestic work. In addition to the company's own specialities, there is a large selection of the products of the leading manufacturers in their respective spheres, and the extra pages devoted to electric vacuum cleaners, dish and clothes washers, etc., should be of material help to the retailing branch of the industry in securing additional turnover. Any trade reader who has not yet received a copy should make a point of applying for it at once, as it will be of direct value at the present season of the year.

Two new publications have come to hand from the **London Electric Wire Co.** and **Smiths, Ltd.** One deals with high-resistance wires, and gives full particulars of their well-known Eureka Resistance Wire, whilst the other is a revision of their Wireless Net Price List, issued earlier in the year. This latter list contains particulars of instrument wires of various sizes on exact weight reels, which information they have found from experience has proved extremely useful to wholesale buyers selling retail. The lists will appeal to all trade readers, to whom they will be sent on receipt of proper trade application.

The August issue of the *Asea Journal*, which has been issued by the **Swedish General Electric Co., Ltd.**, of 5, Chancery Lane, London, W.C.2, contains illustrations and details of various installations in which plant manufactured by the company is or has been installed, including the power stations at Gothenburg, Mansbro', Imathra and other places. Copies will be sent willingly to any reader on application.

From the **Sun Elecl. Co., Ltd.**, of 120, Charing Cross Road, W.C.2, we have received a pamphlet entitled "High Efficiency Lighting." It deals with Sunlite "P.F." reflectors, lanterns and fittings, for use with gas-filled and vacuum type lamps, of which there are excellent illustrations, together with details as to prices, etc., all of which will appeal to electrical installation contractors and dealers in electrical supplies generally. It will be sent to the trade on application.

Automatic and Electric Furnaces, Ltd., of 175, Farringdon Road, London, E.C.1, state that they have made arrangements whereby all furnaces above 25 k.w. will in future be designed in conjunction with the Electric Furnaces, Ltd., of 17, Victoria St., London, S.W.1, and supplied by them. The smaller sizes below 25 k.w. will continue to be manufactured and supplied from the head offices in Farringdon Road, as before.

An interesting pamphlet on the "Selection of Chain-Gear" has been published by **Messrs. Hans Renold, Ltd.**, of Didsbury, near Manchester, and, in view of the rapidly growing attention which is now being given to this branch of power transmission, we expect that the booklet will prove of value to a very large number of our readers, to whom we can recommend it as containing illustrations, tables, and practical notes on lubrication and similar points, which are nearly certain to crop up in the course of their regular engineering routine.

Two new circulars have been issued by the **Consolidated Pneumatic Tool Co., Ltd.** One, No. 36, entitled "Red Giant," gives particulars of the latest type of Pneumatic Reamer which is now being placed on the market, and the other, entitled "Quicker and Cheaper Riveting," gives details and illustrations of two new Boyer Pneumatic Riveting Hammers, which will doubtless prove of direct interest to manufacturing engineers throughout Great Britain and the Colonies.

FOR
TECHNICAL BOOKS
of all descriptions
send enquiries to
S. RENTELL & Co., Ltd.,
36, Maiden Lane, London, W.C.2.
'Phone Gerrard 2460 and
ask for our catalogues.
30 YEARS' EXPERIENCE

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
A PRACTICAL TRADE JOURNAL

SEPTEMBER 19, 1924.

CONTENTS.

PAGE
Electric Passenger Lifts 497
Electricians' Wages 498
Practical Electrical Engineering Hints 499
Sections of Electric Furnaces for Domestic Heaters .. 500
Current Topics 503
Broadcasting in South Africa 505
A Fairy Forest 505
Electrical Installation Work 506
Recent Development in the Control of Band Mill Motors .. 506
Electrical Engineering—Grade I. 508
The Machine Tool and Engineering Exhibition 509
Questions and Answers by Practical Men 509
Various Items 510

ELECTRIC PASSENGER LIFTS.*

BY H. MARRYAT (Member).

SUMMARY.

The author makes a plea for British investigation and design in order to produce a lift more especially suitable to conditions in this country than is possible by following American practice too closely. A number of problems requiring investigation are referred to. The essential parts of a lift and the factors of cost are stated. The advisability of consulting specialist engineers with regard to new construction is suggested. A complaint is made that lift makers are often consulted too late in the development of a new building to enable them to offer the best and most economical scheme. It is maintained that a lift service is more important than the provision of stairs.

The methods employed by the author in calculating the lift capacity required in a building are outlined. A plea is advanced for the employment of lifts of higher running speed and improved acceleration, and the method adopted by the author in an investigation of acceleration problems is described.

A comparison is made between drum and sheave driving. The effects of the position of the winding engine and of rope-reeving upon maintenance cost are discussed. Types of worm gearing and methods of control are described and the limitations of automatic control emphasised. Micro-drive and decelerator devices for attaining automatic floor levelling are detailed and reference is made to a new system of control—the "Auto-Pilot."

Safety devices employed in connection with passenger lifts are described and the record and infrequency of accidents are discussed and commented upon.

A lift is a machine designed to transport a load from one level to another in a vertical or nearly vertical direction by means of a suitably guided car or platform.

Electricity was first used to operate a lift about 1885, and since 1893 has been increasingly employed for the purpose, until now, where electricity is available, it has practically superseded all other forms of energy for new construction. Existing hydraulic lifts are rapidly being converted or replaced by electric lifts. Except where certain special conditions prevail—for instance, short travel and heavy load—when the direct-acting hydraulic lift offers certain advantages, the electric lift has proved itself to be the most economical and convenient machine yet designed for the purpose. This statement being accepted in principle, it will not be necessary to enter into a comparison between electricity and other forms of energy for operating lifts.

The electric lift is becoming an increasingly important feature in modern buildings. The tendency of the great and increasing commercial population of cities to congregate in central areas, and the corresponding increase in site values, is bringing about a continual replacement of older and smaller buildings by newer and larger ones, in which by means of lift service it is possible to take the utmost advantage of the upper floors. Again, the tendency to work shorter hours and at higher speed reinforces the demand for a rapid lift service to replace stairs. It is, therefore, perhaps remarkable that so little has been written or published upon the subject in this country, although there are a large number of works dealing with cranes, conveyors, etc.*

The electric lift was first introduced in America, and in that country has developed in a direction and to an extent to which we are hardly likely to go. We have, however, followed American practice so far as we have been able. In doing so, we no doubt follow the course of least resistance, but the time seems to have come when we should undertake investigation and research upon our own account, with a view to developing a lift more particularly applicable to our own requirements. The conditions in this country are totally different from those existing in America. Here we are restricted in our buildings to a capacity of 250,000 cubic feet, whereas in America there is no such restriction and buildings range in size up to those with 30 to 60 floors and a floor area of 40 acres. On the other hand, we are delightfully free from "red tape" or restrictions of any sort in the design of our lift machinery, whereas in America, where the lift is so important a factor in the daily life of the citizen that it is calculated that in the big cities the lifts run more miles per day than the combined road car and underground services, it has been found necessary to impose restrictions and by-laws which, whilst protecting the interests of the community, are nevertheless a deterrent to the progress of invention and design.

The reason that so little has been written on this subject is no doubt partly because an electric lift is a combination product in which the builder, the electrician and the engineer all take part under the general direction of the architect, and sometimes—too seldom—of the consulting engineer. There are a number of problems concerning the construction of electric lifts which, so far as I know, have not been investigated, and the solution of which would be of great interest and benefit to the industry. It may be that these problems have been dealt with by individual manufacturers, in which case I hope that this paper will be an incentive to publication.

A fundamental problem is that of definition. Owing to the lack of other literature, one in search of information must refer to makers' catalogues, and is at once confronted with a confusion of terms, sometimes used to designate the same thing and sometimes employed by certain makers to differentiate between different things. Thus the terms "Vee" wheel drive, sheave drive, traction drive, friction drive, and half-wrap drive, are all used to designate the same thing. Lift, hoist and elevator are interchangeable terms, as are also service lift and goods lift. I suggest that it would be useful for lift makers to get together and adopt a code of definitions.

---

* Paper read before the Institution of Electrical Engineers.

* Since this paper was drafted a comprehensive work entitled "Electric Lift Equipment for Modern Buildings," by Ronald Grierson, has been published, and may be obtained from S. Rentell and Co., Ltd., 36, Maiden Lane, London, W.C.2, price 15s. 6d. post free.

An electric lift consists essentially of :—

(1) A car or platform suitably designed to transport the required load.
(2) Guides, usually of wood or steel, rigidly attached to the building structure.
(3) Guide shoes attached to the car or platform so as to engage the guides.
(4) A counterweight.
(5) A rope or chain by which the car or platform and counterweight are suspended and which transmits motion from the driving engine.
(6) A driving sheave or drum with which the rope or chain engages.
(7) Gearing (usually worm and wheel) by which power is transmitted from the electric motor to the driving sheave or drum.
(8) An electric motor.
(9) An electromagnetic brake, usually operating upon a drum constructed in one with the coupling between the motor and worm shaft.
(10) A controller designed to start and stop the motor by means of suitable provision in the car or on one or more landings.
(11) Safety devices which may be simple or complex according to the circumstances, and are intended to render accident impossible from the failure of any part of the lift or supply, or from the opening of a landing gate when the car is absent.

The cost of electric lift service comprises interest and sinking fund upon capital expenditure, rent, insurance, maintenance and renewals, energy and attendance. These factors of ultimate cost should be weighed before deciding upon the preliminary specification for any particular lift installation. It follows, then, that this consideration should be given before any scheme has gone so far as to impose limitations upon any of the factors. It also follows that where the architect takes the sole responsibility for the preliminary specification, very great care is required in comparing and examining tenders, as no two makers ever offer quite the same thing. An electric lift is too complicated a piece of machinery to admit of two makers quoting for the same equipment, unless to a very detailed specification such as can only be prepared by a lift engineer, and such important factors as maintenance costs, energy consumption and attendance are greatly affected by the details of the design offered. The actual service given by lifts built to the same general specification and designed to run at the same speed under the same general conditions will also vary considerably, and the number of trips which will be completed and passengers carried in a day by a lift acting upon a smooth and rapid acceleration curve, with accurate floor levelling, will be far greater than with a lift less carefully designed. It is advisable, therefore, in all important new construction that the architect should, in the earliest stages of the project and before any building plans are settled, call in either a consultant specialising in lift engineering, or a manufacturer of experience. Such a consultant, after considering the size and purpose of the building, its situation, the position of entrances, etc., will be able to calculate the probable traffic and advise on the number, size and best position of the lifts required. He will also, upon the same basis of information, be able to advise upon the most economical scheme and the most suitable method of control.

Lift makers complain that they are not consulted until it is too late to influence the general specification, and therefore it often happens that two lifts are installed where one would be more suitable, or, conversely, that one large lift is installed where two smaller ones would give better service. The winding engine has frequently to be fitted in a position where it is impossible to get the best results, and the conditions are sometimes such that the rope-reeving is bad and the total cost of maintenance doubled as a result. Automatic push-button control is installed in places where car-switch control is essential, and expensive alterations have to be made after erection. Again, car-switch control is installed in places where automatic push-button control would be better and would save the cost of attendance.

A really efficient lift service serving the incoming and outgoing as well as the floor-to-floor traffic, is of far more importance than the staircase. Its location should be a primary consideration, and the staircase considered principally in relation to its effectiveness as a fire escape.

(To be continued.)

ELECTRICIANS' WAGES.

Evidence from the London district was heard at the Ministry of Labour last Monday, when the special tribunal set up by the National Joint Industrial Council for the Electricity Supply Industry again met, under the presidency of Mr. W. Addington Willis, to consider the demand of the trade unions for an all-round increase in wages of 10s. a week. Evidence on behalf of the employers was given by Mr. A. F. Harrison, secretary of the Employers' Section of No. 10 (London) Area Council, who contended that the workers were at present receiving wages representing 15 points more than the extra cost of living, and that they were in a better position than before the war, after which Alderman Walker summed up the general case for the employers, stating that any increase in wages would cause an increase in the cost of current, whereas what was wanted was a reduction in the cost in order to encourage the revival of trade. Mr. J. Rowan replied on behalf of the workers, urging that the advance asked for could be given without increasing the price of current except in isolated cases, and the inquiry then concluded with a vote of thanks to the chairman and members of the tribunal.

If you begin by dodging responsibility, it won't be long until you have no responsibility to dodge.

---

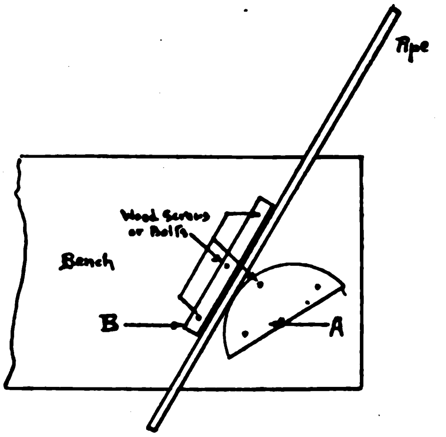
* "Electric Power Applications to Passenger and Freight Elevators," *Transactions of the American Institute of Electrical Engineers*, 1900, vol. 41, p. 325.

Practical Electrical Engineering Hints.

We cordially invite all our readers to contribute to this interesting and useful feature. All hints received will be given careful consideration and will be paid for at our usual rates.—THE EDITOR.

No. 8.—HOW A BENDER WAS MADE FOR PRODUCING REPLICA CONDUIT BENDS.

Very often on conduit jobs the case arises where one has to bend many pipes to same shape, and unless one does not wish them to be an eyesore when erected, considerable time is spent if the ordinary bending block or furnace methods are employed, for it is a very tedious job of the "try, try, try again" type.



Sketch Showing The arrangement & Shape of Material

A quick method I found to overcome this trouble was to construct the simple device illustrated in the sketch, where *A* is a piece of wood shaped to the arc of the bend required, *B* a straight block of wood as shown. Both pieces of wood should be securely fixed to the bench with wood screws or small bolts, while the thickness of the wood will vary, of course, with the size of the pipe to be set.

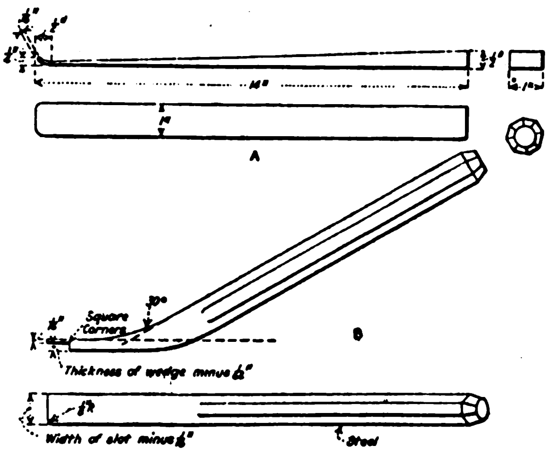
For bending, the pipe is inserted between the two wooden blocks and gradually pulled round, care being taken to avoid nasty kinks occurring; by this means it will be found that any number of pipes can be set exactly the same shape.

This method will be specially appreciated where angle of the bend required is in the neighbourhood of 90 degrees. By making the piece *A* in two pieces it can be used for other size bends.—CHARLES KING.

No. 9.—HOW A TOOL WAS MADE TO DRIVE OUT TIGHT WEDGES IN AN ARMATURE.

I had a generator armature come into the repair shop some time ago, and it was necessary to make a special tool to remove the wedges out of the slots. This tool, shown in the drawing *A*, consists of a long tapered wedge with the front end bent over slightly and polished; this end was used for prying the wedges out of the slots instead of driving them out lengthways.

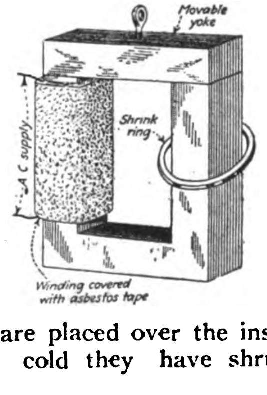
The armature coils were in excellent condition and the construction of the tool had to be made with a certain amount of careful consideration, since a faulty tool may have meant rewinding part of the armature. The wedges were of fibre and the tool was driven in between them and the top of the coil. The result was perfect, because the wedges were forced out of the groove by tearing the material apart, and so no damage was done to the coils or slots. The only precaution was that the tool had to be tapped lightly in starting while bearing down on the outer end. The amount of time saved can be realised when it is mentioned that there were over 350 wedges in the armature.



I have made another tool for removing large wedges; this is illustrated at *B*. The judicious use of this tool will assist in driving wide wedges into the slots as well as removing them.—A. C. ROE.

No. 10.—HOW METAL RINGS WERE EXPANDED BY ELECTRICITY.

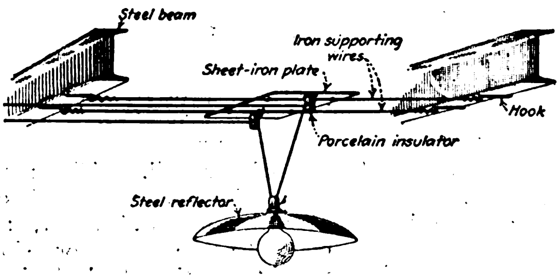
The shrink ring on a turbo-driven D.C. generator armature gave out, and it became necessary to make another one. As is well known, such rings have to be turned up with internal dimensions considerably less than the external dimensions of the insulation. They are then heated, when they expand and, during the expansion, are placed over the insulation, so that when they are cold they have shrunk on to the insulation.



Ordinary methods of heating are likely to incur the risk of dirt getting between the ring and the insulation, in which case the job would be faulty. I, therefore, wound a coil as shown in the sketch and placed it across a single-phase A.C. supply. On the other leg I placed the ring to be heated. The result was that the ring, acting as the secondary coil of a transformer, had current induced into it, and heat was evenly distributed through it. It gave every satisfaction, and I am now making another transformer to heat thrust collars for armature and rotor shafts.—R. H. N. Lockyer.

No. 11.—How a Lamp was Mounted to Withstand High Temperatures.

A lamp was required over a furnace where the temperature was very high. The problem was solved by stretching two iron wires across overhead from one steel girder to another. In the middle of the span a thin sheet-iron plate, 12 in. square, was securely bolted. On this plate were fastened two porcelain insulators carrying two wires in asbestos tubing.



Electrical connection was made between these wires and the supply through an ordinary plug and switch. A 100-watt vacuum type lamp was used in the reflector, as shown in the sketch. It afforded excellent illumination over the top of the furnace. Each week-end the lamp and wires are overhauled and the latter tightened up or renewed as necessary.—H. S. Rich.

SECTIONS OF ELECTRIC FURNACES FOR DOMESTIC HEATERS.

The recessed fire-brick sections used in constructing the heating chambers of large electric furnaces are very well adapted for numerous types of domestic heaters, and the different sizes in which these brick sections are made permit of their being used for various forms of heaters—as, for example, radiators, hot plates, toasters and boiling rings—and they can also be inserted in ovens for both industrial and domestic purposes.

These electric furnace elements consist of comparatively large spirals of heavy gauge wire wound on a mandrel in such a manner that each turn is nearly touching its neighbour. The spirals, after removal from the mandrel, are pushed through restricted annular channels in the bricks, and, whilst free to expand under heat, they are prevented from coming out by reason of the open grooves in the face of the bricks being narrower than the wire spiral. No harm whatever results if adjoining turns in the spirals touch one another.

The method of winding and assembling the heating spirals is identically the same as that employed in the construction of heavy duty electric furnaces for considerably higher temperatures. The grooves in all these elements are closely spaced and shaped so as to prevent the comparatively large diameter heating coils coming into contact with any metal articles placed on the brick element when used for boiling, etc., and yet permitting the utensil to be in very close proximity to the source of heat, which is about 800 degrees centigrade.

Compared to the usual forms of domestic heaters, the greatly increased life of these brick sections is alone an advantage. This improvement is mainly due to the amount of wire used and the gauges fixed for different loadings, both of which are much greater than is usual. These, coupled with the brick base designed for high temperature, ensure a very long life at temperatures about 800 degrees centigrade. It will also be found that mechanically the whole brick element is robust, and makes a substantial and durable domestic appliance, even when mounted in a simple metal surround.

The standard sizes of these recessed bricks are:—

4 in. × 4 in., with four heating spirals ½ in. in diameter.
6 in. × 6 in., with six heating spirals ½ in. in diameter.
8 in. × 8 in., with eight heating spirals ½ in. in diameter.

The usual loading of these bricks for domestic heating purposes is 700 watts, 1,200 watts and 1,600 watts respectively. The last two sizes, if desired, can be fitted with series parallel switches to give three heats.

Furnace bricks are sent out with the large heating spirals fixed in position, and each brick has special refractory ends so that it only becomes necessary for the element to be slipped into a housing and connection made to the two pigtails at each end of the brick.

These bricks present on circuit a compact heating mass which is not only attractive, but appeals to the consumer as being the nearest approach to real solid heat.

From the inquiries and orders already received by the makers, Automatic and Electric Furnaces, Ltd., of 175, Farringdon Road, E.C.1, it is evident that these elements are a convenience to firms who wish to supply their own radiator bodies, sheet metal work, castings, etc., or to build their own ovens.

The September monthly price-list of electrical sundries has just been issued by the **Siemens and English Electric Lamp Co., Ltd.**, of 39, Upper Thames Street, London, E.C.4, and will, as usual, be appreciated by all contractors and trade dealers. Any contractor who has not yet received it should make a point of writing at once and asking for it.

The **British Insulated and Helsby Cables, Ltd.**, of Prescot, Lancs., have just issued a new edition of the British Insulated Pocket Catalogue. It gives in a condensed, but remarkably comprehensive form full details of the company's numerous manufactures, which cover a very wide field, and range from the well-known paper-covered cables as manufactured by them for more than thirty years, right away through to the latest types of overhead trolley line material, welding machines, incandescent lamps, aluminium mats, paper pinions, and other items too numerous to mention. The catalogue should certainly be in the possession of all trade readers. Another catalogue from the same company has as a frontispiece a charming view of the works at Prescot, and contains an excellent series of illustrations showing the numerous types of houses, mansions, castles, and factories in which the Helsby Twin Wiring System has been installed. This system is, of course, well known to practically every electrical contractor in the United Kingdom, as well as to a very large number of our Colonial contractors, who have proved its value in many different situations.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of

CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N. 17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

The Parochial View. The growing list of important contracts placed abroad by municipalities and others on the score of £ s. d. alone and without regard to our national finances prompts further reference to the short-sightedness of such a policy. Because a Swiss, German, American or other foreign tender is lower by a few hundred pounds than any competitive British offers, influential buyers who pride themselves on getting the best possible value for money blandly award their contracts outside the British Isles and hug themselves under the delusion that they have done a jolly good thing for the ratepayers or shareholders whom they represent. By so doing these clever (*sic*) business men altogether overlook the fact that their policy has involuntarily increased unemployment by so many hundreds, or possibly thousands, per week, according to the size of the contract concerned, and that they and their ratepayers or shareholders as the case may be will inevitably pay far more than the comparatively small margin of immediate saving in prime cost in the shape of augmented "doles" and increased local rates.

It is positively astonishing how short-sighted are some local committees and otherwise shrewd directors of companies in determining their buying policy where big contracts are at stake. For example, at a recent meeting of the York City Council the chairman of the Electricity Committee actually accused British electrical manufacturers of profiteering, and stated that if they accepted a British tender for certain turbo-alternator and condensing plant they would be "plundered by electricity people." He further stated that it was clear that the home manufacturers were obtaining far more (profit) than they had any right to do. Evidently Alderman Shipley does not read the daily papers, nor does he study the balance-sheets of our leading electrical manufacturers of such plant as is involved in the present indictment, or he would have realised long since that the rates of wages ruling in foreign countries and the hours worked are far lower in the one case and more plentiful in the second.

It is to be presumed that even in York there is such a thing as a Labour Exchange and that one of its not least important duties is the distribution of "doles" to people who have no work to do and are thus unable to earn the wherewithal to support life. Perhaps the York City Council have a blind eye so far as this department of the city and its finances are concerned. It is, nevertheless, a fact that every pound spent abroad on contracts for municipalities or, for that matter, private trading companies, involves the outlay of two or more pounds at home in "doles." Nor is York the sole offender by any means; Manchester, Hull, Bradford, Glasgow, Aberdeen, Rochdale and even the L.C.C. are equally culpable in their responsibility for adding to unemployment, each of these local authorities having quite recently placed contracts abroad, although not in every case for electrical plant and material. So far as private enterprise is concerned, the public have little or no jurisdiction, and the matter must be left to the consciences of boards of directors or committees of shareholders, but in the case of municipalities this foreign buying mania can very well be suppressed by the local ratepayers whose money is being spent. The November elections are not far away, and this vital factor in local government might profitably be made a plank in several local platforms when the time comes to turn out the incompetents.

Slow Progress. The annual report of the Electricity Commissioners for the year ending last March brings to light the very slow progress which is being made in the development of electricity supply and the modernising of existing generating plant. In England and Wales electricity supply is available for about 74 per cent. of the population, but there are no less than fifty towns with a population of more than 10,000 each which still lack the necessary facilities. The primary object of the Commissioners is to encourage the large power-station policy with wide areas of distribution and to discourage and eventually eliminate the many small and inefficient plants scattered about the country. According to their estimate, no less than six million tons of coal could have been saved and the total output of electrical energy increased at the same time by 26 per cent. during the year under review, so that the vital importance of pushing on with the good work cannot be gainsaid.

According to the Commissioners, there has been a tendency to wait upon events rather than to anticipate them, and in some districts mistrust and political feeling have militated against much needed co-operation. They further hold that it is only by the establishment of a central body with adequate executive and financial powers that a comprehensive scheme of development can be carried out, and add that unless there is a radical change the whole position will call for review. This adverse criticism of electricity undertakings within the purview of the Commissioners is borne out by the generally high price of electrical energy, which is at present militating against its more general adoption for all purposes and is due in great measure to inefficient and out-of-date methods of generation and distribution. It is fairly evident that the Commissioners will have to be armed with greater powers than they at present possess if the electrical millennium for which we all yearn is to be brought about during the lifetime of the present generation.

A Trailing "Earth."

Why do steam vehicles running on rubber tyres trail a chain behind them when in motion is an interesting query propounded and answered by our contemporary, *Motor Transport*. In dry weather the tyres serve electrically to insulate the vehicle from the road surface, under which conditions the friction of the high-pressure steam issuing from safety jets or passing along steam passages at high velocity generates considerable frictional electricity, and, in fact, charges the mass of the vehicle often to an uncomfortable extent so far as the driver and his assistant are concerned. The mass of metal may, in fact, become charged to such an extent as to administer a very severe shock to anyone touching exposed metal. To dissipate this charge a chain is generally trailed behind such vehicles as a flexible conductor to earth thus draining away the static charge as quickly as it is formed.

"Kick" Starting Electric Motors.

A writer in the *Newspaper World* directs attention to an evil which is doubtless by no means confined to electric motors in newspaper printing works, viz., the improper use of starting gear whereby motors may readily be damaged or even burnt out in the event of protective fuses failing at a critical moment. Electric motors require starting gently and with due regard to the sudden rush of current when first switched on to a stationary armature. According to our informant it is common to see workers knock over the starting handle with a blow better suited for reception by a punch-ball. The writer has seen men in certain departments of a printing works use their feet to "control" starters which were placed low down. In this particular case the switches were never used, and both starting and stopping were functions of the "kick starters." These abuses of electrical gear are not performed with the intention of saving time so much as in a spirit of bravado, or, to be exact, a sense of mistaken cleverness. Any time saved by such tactics is usually lost many times over by the replacing of unnecessarily blown fuses. Our informant suggests a threat of immediate dismissal for cruelty to motors as a desirable measure of protection in such cases.

Remote Control by Wireless.

Last week I witnessed the starting and stopping of a rotary sub-station on the Metropolitan Vickers stand at the B.E.E., Wembley, by means of wireless signals broadcast from that company's works at Trafford Park, Manchester, approximately 170 miles away. As a practical demonstration of the possibilities of the remote control of heavy plant without the aid of connecting wires, this interesting experiment is fraught with many possibilities. It involves no fundamentally new principles, for wireless control of electric relays and associated mechanism is of fairly long standing, and the application of the principle to sub-station control is mainly a question of adaptation. The small power control of large power units is really a reversal of the old adage, "Big fleas have little fleas upon their backs to bite 'em; little fleas have lesser fleas, and so *ad infinitum*." In practice the minute wireless waves of energy are boosted up locally by means of valves and utilised to actuate comparatively delicate relays which, in turn, control the local circuits of more powerful relays and automatic switches associated with the rotary switchgear.

Remote control by wireless is, in fact, a much more practical proposition than the "Death Ray," which it also seems to have superseded as a newspaper stunt. Whether it is sufficiently definite and reliable to warrant practical application to the control of important sub-station gear over comparatively long distances remains to be seen. There would appear to be a possibility of interference by signals from other sources attuned to the same receiving conditions and calculated to upset things very seriously unless some definite means have been established of rendering the apparatus absolutely directional and proof against any signal except that normally intended to operate it. In this connection an application of the newly developed "beam" principle of directional wireless on short wave-lengths may prove a solution. The fact remains that the practical possibility of the system has been demonstrated, and there will obviously be instances where its application may help matters considerably, more especially in the Colonies, where the difficulties of maintaining land lines are occasionally almost insuperable.

Regenerative Braking.

With further reference to the question of tramway power losses due to wear and tear of rails and wheel flanges, there would appear to be another contributory cause of higher working costs due to increased power demand per car mile. I refer to the greater and increased frequency of both voluntary and compulsory stops to set down and take up passengers. Similar remarks apply equally to suburban electrified train services. The tendency is to increase the number and frequency of stages both on tramway and railway routes in conformity with building development and the opening up of new residential districts. As a result more frequent braking and subsequent restarting are necessary in connection with both services.

Braking entails a waste of energy every time either a tramcar or an electric train are brought to a standstill, whilst restarting from rest involves a considerable drain upon the trolley wire or live rail for the first half-minute or so until full speed is attained. Thus we lose valuable energy through both processes, and the more frequently they are practised the greater the aggregate loss. I believe that on the tubes a falling gradient from the stations on the leaving track and a rising gradient on the approach side are adopted as adjuncts to regenerative braking and rapid acceleration. Obviously this principle cannot be applied successfully to surface tracks, but some alternative and simple form of regenerative braking would appear highly desirable as an aid to the conservation of energy.

The necessity for frequent starting and stopping of heavily-loaded vehicles such as railway coaches, tramcars or omnibuses is one of the inherent drawbacks to the system of transport by individual vehicles and is a strong argument in favour of the development of the continuously moving platform principle of passenger transport. Here we have a continuously moving mass of varying weight, and the losses due to frequent starting and stopping are entirely absent. The variations in load due to passengers stepping on and off an escalator, which is another form of moving platform, are inconsiderable by comparison, and the principle of the distributed load at constant speed is ideal from an engineering standpoint. We have a similar comparison in the power consumption of an express engine doing long non-stop runs between far distant termini and a locomotive working a suburban train stopping every mile or less to set down or take up a mere handful of passengers. Regenerative braking successfully applied might well prolong the life of electric tramways now in such pitiful case all over the country.

E.D.A. Salesmanship Conferences.

I note with pleasure the programme which has been issued by the E.D.A. in regard to the Salesmanship Conferences to be held in the London area during the session 1924-25. They will, as before, be held at Caxton Hall, and Mr. Beauchamp has prepared a first-class programme of subjects, which should prove of direct interest to all my readers, including, as they do, such items as "Intensive Lighting Development," by Mr. W. E. Bush; "Contracting for Pleasure and Profit," by Mr. Marryat; "Electrical Work in the Retail Shop and Store," by Mr. E. E. Sharp; and four other equally important subjects which space does not permit me to set out at length. They are, however, all items which will appeal to our readers in London, and I hope that all who can attend or who wish for information will write at once to the British Electrical Development Association at 15, Savoy Street, Strand, London, W.C.2, and ask for copies of the programme. There are no fees, and tickets are not necessary, as the object of the conferences is to secure a free interchange of experience, so they represent a really valuable opportunity of gaining first-hand knowledge of the best methods of improving the electrical trade. Therefore, readers, do not fail to attend them.

ELEKTRON.

BROADCASTING IN SOUTH AFRICA.

The Cape Town broadcasting station was opened on Monday last, September 15, at 6 p.m. (Greenwich mean time). It transmits on a wave length of 375 metres, the call sign being "WAMG."

Both as regards the arrangement of the studio and the apparatus employed, the London station of the British Broadcasting Co. has been taken as a model for the new station. The installation consists of a Marconi 6 kw. broadcasting transmitter and microphone such as are used in six of the British main stations, and such as have been installed at Belfast, Brussels, Durban, Rome, Rio-de-Janeiro and Lima. It is expected that a similar station will shortly be erected in Sweden. The Cape Town station is situated at Stuttafords, a departmental store in Adderley Street, and is under the control of the Cape Town Peninsula Publicity Association, which is in close touch with the municipality, and is responsible for the Cape Town Orchestra, which gives concerts at the Town Hall. This arrangement ensures that the affairs of the station are in the hands of men who are experienced in the arrangement of programmes and have exceptional facilities for obtaining the services of talented artistes. Mr. King, of the B.B.C., has gone to Cape Town as Musical Director, and Mr. Thomas, a Marconi engineer, is in charge of the technical side of the station.

The Durban station, which is similarly equipped with Marconi apparatus, is expected to open in November.

A FAIRY FOREST.

One of the most beautiful things at Wembley is the floodlighting of the trees surrounding the ornamental lake, and it is believed to be the first time that this system has been employed in Great Britain for this purpose. In all 44 B.T.-H. projectors are used, each projector being equipped with a 500-watt Mazda gas-filled projector lamp. Some projectors are fitted with green-coloured glasses, and others with amber-coloured glasses, and the effect of the illumination on the foliage is extraordinarily beautiful and spectacular. The projectors are placed upon the ground, and the beams of light are directed upwards, so that the undersides of the leaves are illuminated.

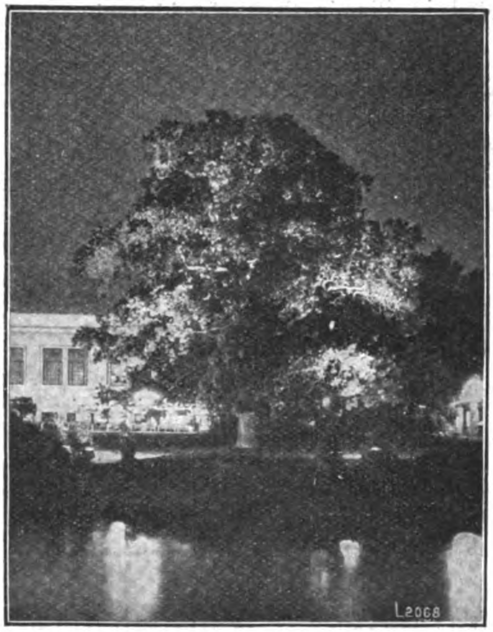


FIG. 1.

It is impossible to describe the appearance of this lighting, and even the photograph which accompanies this article gives only a very inadequate idea of the effect of the illumination. The trees, with their green and amber foliage, form a fairy forest casting reflections of infinite and mysterious beauty upon the waters of the lake. Nothing like it in the way of outdoor lighting has ever been seen before in the country.

Fig. 1 is reproduced from a night photograph showing one of the illuminated trees. It was taken on a moonlight night, hence the comparative lightness of the sky. The gleam of the floodlighting on the leaves is clearly indicated, while the projectors are faintly discernible to the left and right of the tree. In Fig. 2, which is a daylight picture, are shown the batteries of projectors. This arrangement is typical of the whole scheme.

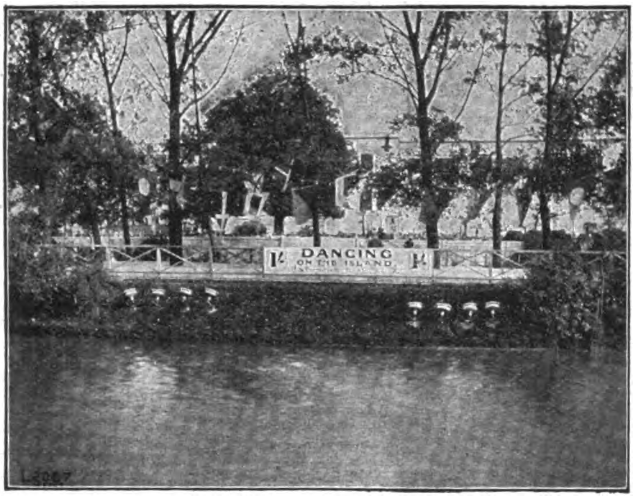


FIG. 2.

All visitors to the Exhibition, and especially those interested in illumination, should make a point of remaining after dark one night in order to see in operation what is, in some respects, the most wonderful lighting scheme in the world.

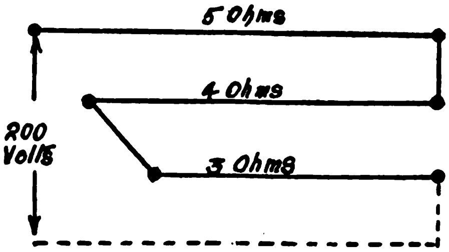
ELECTRICAL INSTALLATION WORK.

By C. Sylvester, A.M.I.E.E., A.M.I.Mech.E.

Solutions to the Questions in Grade I. C. & G. Examination on May 6th, 1924.

(*Continued from page* 472.)

Q. 3.—Three conductors having resistances of 3, 4 and 5 ohms respectively are joined in series across an E.M.F. of 200 volts. Calculate (*a*) the volts dropped in each; (*b*) the watts absorbed in each; (*c*) the total watts absorbed.



A.—In the sketch three conductors are shown connected in series; their total resistance is the sum of the three, which is 12 ohms. If the three conductors were placed across a 200 volt supply the whole of this voltage would be " dropped " in the circuit.

The volts dropped in any part of a circuit depend upon the resistance of the part. Therefore, in the case we are considering, the voltage drop would be proportional to the resistance. In the 3 ohm conductor there would be a voltage drop of:—

$$200 \times \frac{3}{12} = 50 \text{ volts.}$$

In the 4 ohm conductor:—

$$200 \times \frac{4}{12} = 66.6 \text{ volts.}$$

and in the 5 ohm conductor:—

$$200 \times \frac{5}{12} = 83.3 \text{ volts.}$$

The watts absorbed in a conductor is found by I^2R, where I is the current in amperes and R the resistance of the conductor. Since the three conductors are in series the current will be 200 ÷ 12 = 16.6 amperes, or, say, 17 amperes. Therefore:—

17 × 17 × 3 = watts absorbed in 3 ohm conductor = 867 watts.

17 × 17 × 4 = watts absorbed in 4 ohm conductor = 1,156 watts.

17 × 17 × 5 = watts absorbed in 5 ohm conductor = 1,445 watts.

The total watts absorbed will be the sum of the watts absorbed in each conductor; this is 3,468 watts. This may be checked against volts × amperes = watts which is 200 × 17 = 3,400 watts, the slight difference being due to taking 17 amperes as the current instead of 16.6 amperes.

(*To be continued.*)

RECENT DEVELOPMENT IN THE CONTROL OF BAND MILL MOTORS.

A new control for band saw motors that greatly simplifies the operations of starting and stopping the mill has been developed by the Westinghouse Electric and Manufacturing Company, of Pittsburg, U.S.A. With this control, the motor can be started and stopped in the minimum time, and reduced speeds can be obtained for slow-speed sawing and slow-speed band-wheel grinding.

The control can be used with any standard alternating current wound rotor type of motor. For making

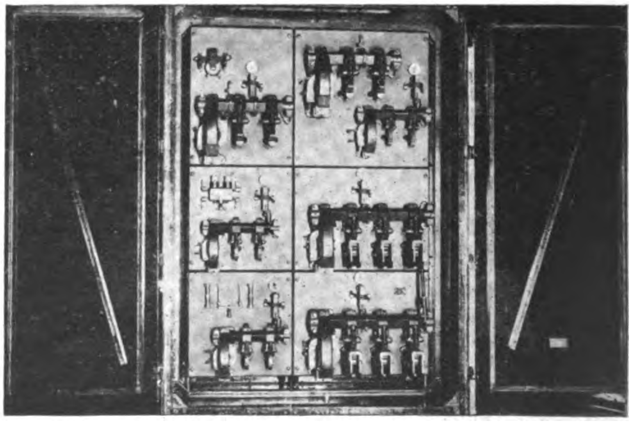


FIG. 1.—FRONT VIEW OF CONTROL PANEL FOR BAND MILL MOTOR.

1900 25

Estab. 1900

50 1925

Nearly 25 years ago my career was undecided. I keenly felt the need of expert and fatherly advice. In pondering the possibilities of my own future I realised the fact that thousands of others must be in the same predicament, and consequently, I felt sure there must be a good opening for someone who could give that assistance which must be so badly needed.

I then decided that I would become that expert adviser and universal father, and devote my life's work to helping and guiding those who are to a certain extent in the dark, or in the rut; also those who have ambition to take a real place in the world's affairs.

I founded the Bennett College in 1900. I have had 25 years of unbroken progress because my advice has been good; the tuition has been complete, and the success of the students has been phenomenal.

During these 25 years of success I have helped thousands of young men into good employment and thousands of older men to better appointments. Can I help *you*? My Advice is Free; you incur no obligation.

WE TEACH BY POST

Have You ANY Ambition?

J. H. Bennett

Most Moderate Charges Payable Monthly.

We specialise in all Exams. in most of the following subjects, and we guarantee tuition *until successful*. No extra fees. Expert Tutors for every Department.

COMMERCIAL
Accountancy
Advertising and Salesmanship
Auditing
Banking
Book-keeping
Commercial Arithmetic
Commercial Law
Company Law
Costing

COMMERCIAL Cont.
Economics
English and French
Executorship Law
Foreign Exchange
Modern Business Methods
Secretaryship
Workshop Organisation

TECHNICAL
Architectural Drawing

TECHNICAL Cont.
Building Construction
Clerk of Works' Duties
Aviation
Boiler Engineering
Boiler Making
Chemistry
Civil Engineering
Concrete and Steel
Draughtsmanship
Electricity

TECHNICAL Cont.
Engineering
Foundry Work
Internal Combustion Engines
Marine Engineering
Mathematics
Matriculation
Metallurgy
Mining
Mine Surveying

TECHNICAL Cont.
Motor Engineering
Naval Architecture
Pattern Making
Sanitation
Shipbuilding
Structural Engineering
Surveying and Levelling
Telegraphy and Telephony
Wireless Telegraphy
Works Managers' Course

WRITE FOR FREE BOOKLET to The Bennett College, Dept. 11, Sheffield, naming the subject you are interested in. Please state your age. Parents should seek our advice for their sons. Courses specially combined to meet all requirements. Why stay in the rut?

ESTABLISHED 1900
The Bennett College
TECHNICAL
SHEFFIELD
COMMERCIAL
DEPT. 11.

ENGINEERING DICTIONARY
PART ONE FREE.
To extend the name of the BENNETT COLLEGE, we are publishing an Illustrated Encyclopædic Dictionary for Engineering, Civil, Motor, Elect., Mech., &c. You may have Part 1 FREE. Send for Part 1 to-day; you are under NO OBLIGATION.

EDA

WHEN YOUR CONSUMERS GO TO WEMBLEY

Make sure they know how to find the E.D.A. Exhibits

"Electricity in Service"

EXHIBITION PLANS
MAILING CARDS
BOOKLETS
POSTERS
POSTER STAMPS

can be obtained from the E.D.A. Samples free.

Electricity Suppliers and Contractors cannot fail to obtain benefit from the circulation of these publications amongst their Consumers and Customers.

Send for Samples:

THE BRITISH ELECTRICAL DEVELOPMENT ASSOCN.
15, SAVOY STREET, W.C.2.

The Third

MACHINE TOOL AND ENGINEERING EXHIBITION

OLYMPIA, LONDON.

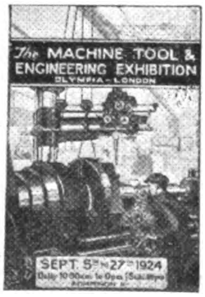
September, 5th-27th, 1924.

THE GREATEST EXHIBITION OF **MACHINERY IN OPERATION IN THE WORLD.**

Admission 1/-

Daily - 10.30 a.m. - 9 p.m.

Sats. - 10.30 a.m. - 10 p.m.


The MACHINE TOOL & ENGINEERING EXHIBITION
OLYMPIA - LONDON
SEPT. 5th to 27th 1924

Organised by

The MACHINE TOOL TRADES ASSOCN.

quick stops at the time of changing saws and also in case of emergencies, the control is designed for automatically plugging the motor. Special features are provided for the safety and convenience of the operator, and he has complete control over the motor at all times through a small drum master switch.

This small master drum, which can be mounted alongside of the sawyer, is so combined with the main contactor panel that it accomplishes the automatic acceleration at the time of starting the motor and also automatically inserts the proper resistance in the motor circuit at the time of reduced speed sawing. To start the motor all that is necessary is to place the handle in the running position, and the control automatically accelerates the motor to full speed. If, however, it is desired to saw at approximately 50 per cent. speed for band-wheel grinding, the operator simply places the drum handle in this position and the motor rotates at approximately half speed. To stop the saw for changing, the drum handle is held in the plugging position until the saw comes to a complete stop. If it is simply desired to stop the saw at the end of the working period, however, the drum handle is returned to the off position. Under this condition the saw comes to a drift stop instead of a quick stop.

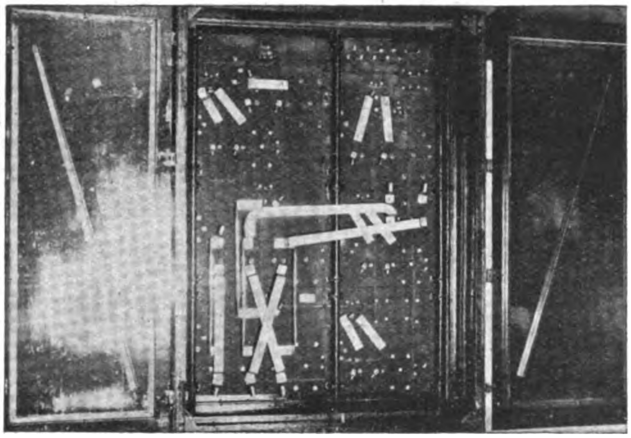


FIG. 2.—REAR VIEW OF CONTROL PANEL FOR BAND MILL MOTOR.

The proper number of points are provided for the acceleration of the motor to give the proper starting torque and insure safe and satisfactory starting with the minimum disturbance of the power circuits. The automatic features for starting from the master drum switch are controlled by current-limiting relays for closing each successive step. Overload protection is provided for the motors by means of inverse time-limit relays which are arranged to stop the motor in case of sustained overload, but will not operate with the ordinary peaks encountered in operation. In addition to the overload protection, the control is designed so that in case of low voltage or failure of power, the motor is automatically stopped and cannot be started again until the master drum is first returned to the off position.

The automatic contactors furnished with this equipment are of standard design and are interchangeable with other contactors of the same make for similar ampere capacities. The control contactors are mounted on slate sections and assembled on pipe or angle-iron framework. The panels can be arranged for use either open or cabinet enclosed as desired. The control is designed for 440, 550 or 2,200 volt service. In all cases, however, the operator is not required to handle the high voltage, since a low voltage is used on the drum master switch.

ELECTRICAL ENGINEERING—GRADE I.*

Solutions to 1924 Examination Questions of the City and Guilds Institute.

BY EDWARD HUGHES, B.Sc. (Eng.), A.M.I.E.E.

Q. 1.—Define the Board of Trade unit of electrical energy. Calculate the potential energy in Board of Trade units stored in a reservoir of 100 million gallons capacity, situated 200 ft. above the turbine house.

A. 1.—The Board of Trade unit of electrical energy is the kilowatt-hour and may be defined as the work done in one hour when the power remains constant at one kilowatt.

The potential energy of a mass M lbs. at a height h feet is $M\,h$ foot-lbs.

Now one gallon of water weighs 10 lbs.

$\therefore$ weight of 100 million gallons of water

$$= 100 \times 10^6 \times 10 \text{ lbs.}$$

$\therefore$ potential energy stored in reservoir

$$= 100 \times 10^6 \times 10 \times 200 \text{ ft.-lbs.}$$

$$= \frac{100 \times 10^6 \times 10 \times 200}{33000} \text{ H.P.-minutes.}$$

$$= \frac{100 \times 10^6 \times 10 \times 200 \times 746}{33000 \times 1000 \times 60} \text{ kw.-hours}$$

$$= 75400 \text{ kw.-hours or B.o.T. units.}$$

Q. 2.—The moving coil of a permanent magnet instrument has a resistance of 10 ohms and requires a current of 50 milliamperes to give a full scale deflection. Calculate the value of the shunt required to enable the instrument to read currents up to a maximum of 50 amperes. Explain how the final accurate adjustment would be made.

A. 2.—
$$\left.\begin{array}{l}\text{P.D. across instrument when}\\ \text{carrying maximum current}\end{array}\right\} = \frac{50}{1000} \times 10 = 0.5\ V$$

$$\text{Current through shunt} = 50 - 0.05 = 49.95$$

$$\therefore \text{Resistance of shunt} = \frac{0.5}{49.95} = 0.01001 \text{ ohm.}$$

Final accurate adjustment may be made either on the shunt or on the manganin or eureka resistance, usually connected in series with the moving coil. If the latter, when used by itself, is to read millivolts or if it is to have two or more shunts, the second method is not possible and the final adjustment must be made on the shunt. When the potential terminals of the shunt are attached to the lugs used for the main-current terminals, the adjustment can be made by altering the cross-section of the strip. Should the potential terminals be tapped off the strip, the final adjustment can be made on these tappings; for example, increasing the depth of a sawcut near a tapping alters the potential of that tapping.

---

* Books recommended are *Elements of Electrotechnics*, by Young (7s. 10d. post free), and *Technical Electricity*, by Davidge and Hutchinson (13s post free), both from S. Rentell and Co., Ltd., 36, Maiden Lane, London, W.C.2.

(*To be continued.*)

THE MACHINE TOOL AND ENGINEERING EXHIBITION.

The third exhibition organised by the Machine Tool Trades Association was opened by Lord Askwith at Olympia, on September 5, and will remain open till Saturday, September 27.

In some respects it is even more interesting than the 1920 Exhibition, which at the time was acknowledged to be by far the largest, most interesting, comprehensive and representative display of moving machinery that the world has ever seen. Then were shown the machines and appliances which had been devised or hastily improvised under the stern necessities of war; now, these same machines and tools, which had been invented for special purposes, have been improved and consolidated in design until they have become integral and indispensable parts of engineering equipment. It will be plain for all to see that the standard of the British Machine Tool Industry never stood higher than it does to-day, and even the uninitiated will not fail to appreciate the beautiful lines and finish of the machine construction, and the efficiency and accuracy of their work.

The range of exhibits is so varied that the machinery installed at Olympia would be capable of producing any metal article, from the smallest screw to the largest locomotive.

When it is remembered that many of the single machines weigh as much as 20 tons, and one no less than 45 tons—this being the heaviest machine tool ever shown in operation at any exhibition in the world—it will be realised that every manufacturer of electrical apparatus who wishes to turn out the best quality article at a minimum cost, and thus meet and overcome foreign competition, ought to visit Olympia and inspect carefully the machine tools which will best help him to attain that object. The following types of machines, all in actual operation, form a part only of the range on view, viz.: Boring, milling, shaping, planing, grinding, slotting, gear-cutting, sawing, and in addition there are lathes of many varieties, power hammers, drop stamps, and wood-working machinery of all sorts. Needless to say, the electric drive is universal, and it is pleasing to see that the Brookhirst Switchgear Co. are well to the fore, their control apparatus being installed at quite a number of the exhibits. Other electrical firms showing are the Electrical Apparatus Co., Ltd., of Vauxhall; Igranic Electric Co., Ltd., of Bedford; Reavell and Co., Ltd., Ipswich, etc. The exhibition should be of direct interest to our readers and to engineers generally.

Trade readers will be interested in the well-printed 36-page catalogue of Mazda electric lamps, which has just been issued by the **B.T.H. Co.** The centre pages are well printed in colour, and give a good idea of the different varieties of colour-sprayed, daylight and white Mazda lamps, in all of which there should be good business. The catalogue is referred to in our article dealing with the Mazda publicity campaign, and will be willingly sent to all dealers in incandescent lamps on receipt of the proper trade application.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.

ANSWERS: A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 188.

I have under my charge a large number of mercury motor-meters for overhauling and calibration. I would like some details as to how I can clean mercury with acid and subsequently distill it in vacuo. Any other method of purifying mercury will be helpful. I have been sending the mercury to Johannesburg to a chemist, but I wish to do the cleaning myself.—JOHN J. WUD, Witenhage, C.P. South Africa.

QUESTION NO. 189.

Can you give me a reliable method of adjusting the ordinary microphone transmitter (carbon) fitted to magneto ringing telephones fitted with induction coils in a private exchange?—"MAGNETO."

(Replies to Questions Nos. 188 and 189 must be received not later than September 27, 1924.)

Reviews of Books, &c.

[*Books noticed in this column will be sent from* ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage* (*minimum* 2d.), *and orders will be appreciated.*]

BRITISH STANDARD SPECIFICATION FOR NORMAL TYPE TUNGSTEN FILAMENT ELECTRIC LAMPS. (No. 161—1924. Price 1s. 2d., post free.)—The above specification, which has just been issued by the British Engineering Standards Association, supersedes B.E.S.A. Publication No. 133—1921 Normal Type Vacuum Tungsten Filament Lamps.

It contains, besides general clauses covering all types of tungsten filament lamps, schedules setting out the required performance, etc., for gasfilled and vacuum type lamps. Further schedules for traction lamps, train-lighting lamps, etc., are being prepared, and will be added as and when ready.

In this new specification, the basis of the rating of lamps has been changed, the life performance being based on candle-power maintenance throughout life, whereas the previous specification (No. 133—1921) was based on initial performance with a limited reduction in candle-power and efficiency. Another important change is the use throughout the specification of lumens as well as candle-power.

When No. 133—1921 was prepared, the use of the term "average candle-power" was decided on in preference to "mean spherical candle-power," but the

British National Committee of the International Illumination Commission recommended that this term should be discontinued and the old term revived, as the term "average candle-power" had not come into use, and had proved misleading, and the B.E.S.A. has adopted this recommendation.

The figures for the vacuum lamps show a substantial tightening up of the limits for candle-power has been introduced. With regard to the figure for the gasfilled lamps, this part of the specification has been prepared in response to repeated and urgent requests which have been made to the Association. The limits given are necessarily wider than those allowed in the schedules for vacuum lamps, owing to the fact that the present state of the art is not so fully developed, but the values included represent the best British practice, and will be revised as soon as further development makes this possible.

In view of the change in the basis of computing the life test, an appendix has been included, setting out an example of computation of life performance which should be useful to those making the tests.

Various Items.

Tenders Accepted.—Tenders from the G.E. Co. have been accepted by the G.P.O. and by H.M.O. Works for 12 months' supplies of metal filament vacuum, gasfilled and carbon filament lamps.

Quotations Wanted.—The Grey Electric Power Board, N.Z., invite tenders for a steam-driven generating plant. Specifications, etc., at the D.O.T. (Room 52), 35, Old Queen St., S.W.1.

Useful Books.—Now that many of our readers are thinking of purchasing books for perusal during the coming autumn evenings, we would recommend them to write at once to Messrs. Chapman and Hall, Ltd., 11, Henrietta Street, Covent Garden, London, W.C.2, and ask for copies of their catalogues E.2. These contain details of many technical books of direct value to electrical engineers generally.

Belfast.—The Corporation Tramways Committee have decided to advertise for a new manager and engineer for the tramways undertaking. The proceedings lasted for over two hours, when the meeting decided to recommend the Council to advertise for a new manager and engineer, and appoint Mr. Carlisle, the present chief of the department, assistant manager at his present salary. It is understood that Mr. Carlisle is prepared to accept this arrangement.

"**The Mechanical Boy.**"—We are glad to hear that the new paper bearing this title, which has been issued by Messrs. Percival Marshall and Co., of 66, Farringdon St., London, E.C.4, is meeting with a very hearty welcome in all parts of the kingdom, and can recommend it to those readers whose juveniles may be interested in mechanics and electricity, in an amateur sense. The price is 3d. weekly, and it can be obtained through any bookstall or newsagent.

Cutting Lubricants and Skin Diseases.—Messrs. Sterns, Ltd., of Royal London House, Finsbury Square London, E.C.2, who are the makers and proprietors of Super-Screwol, Lardinol and Sapanoline Cutting Oils, etc., will send, upon receipt of a post-card, free of charge to any works manager or engineer, a copy of the Government publication dealing with prevention of skin diseases amongst workers engaged in screw cutting, drilling or other processes necessitating the use of cutting lubricants.

All-British Wireless Exhibition.—At this exhibition, which is due to be opened at the Royal Albert Hall on September 27, and will remain open until October 8, there will be a magnificent display of wireless apparatus by the leading manufacturers, and we note with pleasure that Messrs. A. J. Stevens and Co., Ltd., of Wolverhampton, whose new wireless set was illustrated and described in our issue of the 5th inst., are making an excellent display of their new model receivers and accessories. They are also showing a number of the A.J.S. patent variable condensers, and their well-known loud-speaker. Other exhibits include pedestal cabinets, tubular steel telescopic wireless masts, and wireless supplies generally.

Removal.—Messrs. Hopkinson Induction Motors have removed to more commodious offices and works at Willesden Lane, North Acton, London, W.3. Telephone 2763.

Switzerland.—A confidential report on the market for wireless apparatus in Switzerland (Zurich district) has been prepared, and a copy thereof, together with full particulars of the Special Register service, may be obtained by U.K. firms from the D.O.T., 35, Old Queen St., London, S.W.1.

Bock Wanted.—We have not yet heard if any reader can supply a copy of the book on the "Theory of the Submarine Telegraph and Telephone Cable," by Malcolm, for which an advertisement has been appearing in our prepaid columns. We should very much like to obtain it for our client if possible.

Denmark.—This summer the Danish Meteorological Institute has again been issuing weather forecasts per wireless in connection with the harvest, and farmers everywhere in Denmark are exceedingly interested in them. It is, therefore, very probable that when the Finance Bill is introduced the Rigsdag will propose on behalf of the farmers that the Institute have their own wireless transmitting station in order to be able to issue the weather reports in a satisfactory manner.

New B.T.H. Branch at Bristol.—The B.T.H. Co. have long realised the necessity of providing proper showroom facilities in various parts of the kingdom, and on Monday, September 15, they opened a new branch depot at 119, Victoria St., Bristol. Telephone: 6610 and 6611. Telegrams: Asteroidal Bristol. Complete stocks of Mazda lamps, B.T.H. lighting equipment, wiring supplies and radio apparatus will be held at this new branch, which is intended to cover the South West of England, and the trade are invited to take full advantage of the facilities and business opportunities thus afforded.

C. and G. Programme for 1924-25.—The City and Guilds programme for the new session has just been issued, and may be obtained from Messrs. S. Rentell and Co., Ltd., 36, Maiden Lane, W.C.2, price 4s. net, post free. It has been carefully revised and brought into line with the latest regulations, and we can congratulate the editor on the improvement in regard to the preparation of the lists of works of reference, which are now combined in an appendix, and can be referred to much more easily than heretofore. The book is of direct value to all teachers, and will prove useful to students.

The B.E.A. Bulletin.—Supplement No. 8 of this bulletin opens with a hopeful article entitled "Out of the Doldrums," dealing with various trade inquiries which have been received at the B.E.A. stand during the period of the Exhibition ending August 31, from which it appears that the results are likely to make an immediate appeal to all thinking engineers. Taken all round, the trade outlook, as a result of the great show at Wembley, may be considered much more hopeful. Let us trust that the actual results in the way of firm orders will be eminently satisfactory. The officials of the Association are certainly doing their best to promote the interests of their members.

GRINDERS
DRILLS
"DEPENDABLE"
& POLISHING LATHES
MARRYAT & PLACE, ENGINEERS.
28 HATTON GARDEN, E.C.2.

Sample Pair Sent on Approval for 8/6
Made of Pure Para Rubber soft and durable and unaffected by climatic conditions
DAVID MOSELEY & SONS.
Limited,
ARDWICK MANCHESTER
MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

SEPTEMBER 26, 1924.

CONTENTS. PAGE

The Value of Drawings to the Progress Department 511
Concrete Power Stations 512
Electrical Engineering—Final Grade 513
The Junior Institution of Engineers 514
A "Real" Osram Baby 514
Chloride Exhibits at the Albert Hall 514
Current Topics 517
The A.T.M. Co.'s Exhibit at Wembley 519
Questions and Answers by Practical Men 521
Electric Passenger Lifts 522
Electrical Installation Work 523
Trade Notes 523
Various Items 524

THE VALUE OF DRAWINGS TO THE PROGRESS DEPARTMENT.

In very many factories it is usual for the progress department to be in possession of a complete set of blue-prints. The practice is that, immediately the drawing is approved, a print is sent to the section leader handling the class of manufacture concerned, and this individual, after taking what notes he considers necessary, initials the print, which is then placed on file for future reference.

This is a common-sense procedure, for the blue-print is of the utmost value to the progress man. In the first place, it may be that he cannot give delivery dates to the manufacturing departments until he knows that all drawings in connection with the job have been issued; consequently he keeps a record of the blue-prints received by him, and, when the final one is to hand, he knows he is quite safe in issuing the delivery instructions to the various departments.

Some drawings give information relating to patterns and tools, and, assuming that a blue-print covering a casting is received, the progress man is able to determine: (1) whether a pattern must be made; (2) whether an existing pattern can be modified; and (3) whether an existing pattern is suitable for the job. If the drawing shows that a new pattern must be made, or an existing pattern modified to suit, he can immediately get into touch with the pattern shop; whilst, if an existing pattern is quite suitable, he can at once issue delivery instructions to the foundry.

In like manner many machining drawings state whether the necessary tools, jigs, fixtures, etc., are in existence, or whether any or all have to be made. If the former, he knows that the machining can be proceeded with, but it would be ridiculous were he to give delivery dates for the machining when new tools have to be made. His first move in these circumstances would be in the direction of the tool-drawing office, and, after ascertaining that the tool drawings were ready, he would then obtain promises of delivery from the tool room, and use these as the basis of his machining delivery date.

The blue-print also shows him whether the detail is similar or otherwise to the standard. He may be interested in a semi-standard line of manufacture, which means that, although in the main the component parts conform to the standard, there is a probability of certain details going away from this. It is essential, therefore, that any part deviating from the standard should be known to him, otherwise he may give information that is not strictly accurate.

It must be remembered that in many factories delivery dates are not actually based upon time allowances for the various operations included in manufacture. In the case of the semi-standard product, an estimated time is given for the completion and despatch of the unit, and this time is split up among the various departments interested in the product, according to the amount of work to be done in each.

Nothing exasperates a department foreman so much as an obviously impossible delivery date, and the progress man must see that he does not err in this respect. So long as the various component parts conform to the standard he has little to fear, but it is when the special details appear that he must be wary. The blue-print will, at all events, put him on his guard, and it is his own fault if he miscalculates.

Just as it is important that a print off each new drawing is received in the progress office, so also is it important that every change made upon a drawing is brought to the notice of the progress man. It is a mistake to assume that this does not matter, for the consequences of omission in this direction may be serious.

It is not enough for the print showing the alteration to be handed to the boy in the progress office, and the old print taken in exchange, for no purpose is achieved. Yet in many cases this is done, and no one is more surprised than the progress man when information is received to the effect that the delivery date cannot be met owing to a change in design.

In the factory handling work on a repetition basis the same procedure must be observed, although in this case the importance varies in accordance with the range of the progress man's activities. In some factories all operation work cards are issued from the progress office, and it may be also that this office controls, to some extent, the activities of the purchasing department. In such cases it is obvious that changes in design are of great interest to the progress man, and his attention must be drawn to these at the earliest possible moment, so that he can advise all interested parties.

To emphasise the importance of this, it is proposed to quote a few specific cases. It may be remarked that the instructional department referred to is the progress department, but the point applies with equal force to any instructional department, no matter what its name may be.

(1) Shafts were turned in large quantities to a specific drawing and placed into stock. They afterwards required drilling, but the arrangement was for this operation to be done later when the shafts were assembled with gears. At a later date it was decided to make a drilling jig to render the holes interchangeable, and the drawing was altered accordingly.

The change was not reported to the progress office, and as this department was responsible for the issue of the operation work cards, no orders were issued for the drilling operation, and the shafts still continued to be placed in the store without this operation being done. It was some time before the inspector realised that the drilling should be done before the shafts were placed in stock, and then application was made for a work card. This, however, could not be issued until instructions had been received, and then all the shafts in stock had to be withdrawn for this operation to be done.

(2) A pin, made to a certain drawing, was used in connection with two or three different assemblies, and the batches for the machining operations were fairly large. It was subsequently decided to use a slightly shorter pin for one of the assemblies, leaving the existing pin for the remaining assemblies. A new drawing for the shorter pin was made, but, strange to relate, no print off this drawing was issued, and production went on as before. Several months elapsed before the matter was noticed, and during that time thousands of pins had been made.

Obviously this was not a businesslike proceeding, for it is assumed there was a reason for the change, otherwise it would not have been made. As changes in design are either in the interests of utility or economical manufacture, one or the other must have suffered in the two instances given. Had proper co-operation existed between the drawing office and the progress department the matter in each instance would have been efficiently handled in the following manner :—

Dealing first with example (1) a print off the altered drawing would be sent to the progress office, and the progress man, by comparing this with the print already in his possession, would see that a drilling operation had been added. He would thereupon ask the planning department for authority to add the new operation to the operation list, and the progress record card would be amended accordingly. He would then issue instructions to the storekeeper to send the parts in stock to the inspection department to be reported upon in connection with the new blue-print, and, upon receipt of this report, he would issue a work card for the extra operation to be taken in hand.

In the case of example (2), the existing drawing and the new drawing would be cross referenced, and a print off each would show the progress man the nature of the change. He would ask the planning department for the necessary authority, adjust his record card and ascertain from the storekeeper the quantity of the detail in stock. Should this quantity be large, he would raise the point as to whether it would be advisable to carry on as heretofore until such time as the stock reaches reasonable proportions, taking into consideration the fact that, once the new pin is made, the use of the older type of pin is restricted.

One more example may be cited, this referring to a detail purchased from an outside source. The part in question is a small screw, the length of this being 7/16 in. Owing to certain details included in the assembly being slightly modified, the length of this screw has to be increased to 9/16 in., and the drawing is altered accordingly.

Prints off this altered drawing were sent to the inspection department and the drawing store, but no print was sent to the progress department, which in this instance controlled outside purchases. After a time a consignment of screws was received, but rejected by the inspector as not being in accordance with the drawing.

The screws were accordingly returned to the supplier by the buyer, who had no idea that a changed dimension had been shown upon the drawing. The supplier was mystified, and sent a letter asserting that the goods were in accordance with the drawing, and this letter was shown to the inspector. The latter was still emphatic that the goods were not correct, and a perusal of the drawing showed that a dimension had been altered three months before, whereas the goods had been ordered several weeks earlier.

The supplier was asked to return his print, which was found to be off the original drawing, and that, so far as he was concerned, the goods were quite in order. A new print was then sent, together with an apology, and the goods were perforce accepted.

Not only was a good deal of unnecessary expense involved in paying for goods which could not be used, but production was delayed whilst new parts to the changed drawing were being made. Apart from this, the return of the parts to the supplier on the grounds that they were incorrect created a bad impression in the mind of the supplier, which was not altogether obliterated by the subsequent apology. All this trouble could have been avoided had the system laid down a hard and fast rule that the progress department must be in possession of a complete set of blue-prints, absolutely up-to-date, for this would have ensured a copy of every change automatically reaching that department. It may be that many of the changes do not directly affect the progress man, but it should not be for the drawing office to determine. Far better to have no exceptions, and then there will be no blunders.

CONCRETE POWER STATIONS.

The fact that the new 50,000-kw. station at Norwich is being built throughout with concrete blocks, and from an architectural point of view will be a particularly fine building, much superior to most existing power stations, serves to remind us of the great progress being made with the use of concrete.

Engineers have, of course, long been familiar with the applications of this material to foundations, floors, coal and ash bunkers, conduits, and water and oil tanks, but the British Empire Exhibition at Wembley in particular has shown us also the remarkable possibilities of concrete in all kinds of constructional work, even for such unlikely subjects as electric light standards and telegraph poles for overhead transmission lines. One of the most valuable of the recent developments in the technique of concrete is the silicate of soda process for hardening, the value of which is now being widely recognised, and Messrs. Brunner Mond and Co., Ltd., who have carried out extensive research work on the subject, have just issued a new and enlarged edition of their well-known publication, "Silicate of Soda and Concrete." This can be obtained on application to the firm's address, Northwich, Cheshire, and we can certainly recommend everyone interested to send for a copy, as it contains a very clear and concise description of the whole process, especially the chemical reactions that give rise to the beneficial effects and the method of application.

ELECTRICAL ENGINEERING.—FINAL GRADE*

Solutions to Questions set at the 1924 Examination of City and Guilds Institute.

By Edward Hughes, B.Sc., A.M.I.E.E.

(*Continued from page 499.*)

Q. 5.—What is meant by the natural period of oscillation of an alternator connected to constant-voltage and constant-frequency bus-bars? Calculate the time for one complete oscillation in the case of a 3,000-*kVA*, three-phase alternator running at 1,000 revolutions per minute when it is connected to 6,000-volt, 50-frequency bus-bars. The alternator has a synchronous reactance of 20 per cent., and the moment of inertia of the whole moving system is 250,000 lbs.-feet².

A. 5.—Suppose an alternator *A* to be running across the bus-bars in parallel with other alternators. If the speed of *A* decreases momentarily, a synchronising current is set up trying to pull *A* back into its original phase position. Consequently *A* accelerates, and is momentarily rotating faster than the other alternators. Even at the moment when it has caught up with the other machines and when there is, therefore, no synchronising torque, *A* is still running at a slightly higher speed and its inertia consequently carries it beyond the normal position. But the direction of the synchronising torque is thereby reversed and *A* is retarded. Its inertia again causes it to swing behind its normal position relatively to the other machines. This phase swinging would continue indefinitely were it not for the damping action of the losses in the pole faces and in the damping winding (if any). The natural period of oscillation of an alternator is therefore the time of one complete swing of that alternator relatively to the other machines with which it is operating in parallel.

Suppose OB and OA in Fig. 4 to represent the voltage across the bus-bars and the e.m.f. generated in alternator *A* respectively, the two quantities being assumed equal for simplicity. Also, suppose θ to be the angle of displacement of *A* relatively to the other machines at a particular moment. Then the resultant voltage is given by OC, where

$$OC = 2\,OB \sin \theta/_2$$
$$= 2\,V \sin \theta/_2$$

where V = bus-bar voltage per phase.

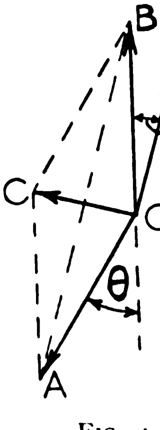


Fig. 4.

Since the resistance of the windings is very low compared with the reactance, the synchronising current OI lags practically 90° behind OC.

$$\therefore B\hat{O}I = \theta/_2$$

If the output of the other machines be large compared with that of *A*, the impedance of the former may be neglected in comparison with that of the latter. Hence, if Z be the synchronous impedance per phase of alternator *A*,

$$\text{synchronising current} = I = \frac{OC}{Z} = \frac{2\,V \sin \theta/_2}{Z}$$
$$= 2\,I_{sc} \sin \theta/_2$$

where I_{sc} = steady short-circuit current of *A*.

If the machine has m phases,
total power supplied from bus-bars to *A*

$$= m\,V\,I \cos \theta/_2$$
$$= 2\,m\,V\,I_{sc} \sin \theta/_2 \cos \theta/_2$$
$$= m\,V\,I_{sc} \sin \theta$$
$$= m\,V\,I_{sc}\,\theta$$

since θ = sin θ for small displacements.
If α = the same angular displacement as θ, but expressed in mechanical radians,
and p = number of pairs of poles,
then since there are 2π mechanical radians in one revolution, but 2π electrical radians in the movement through two pole-pitches,

$$\theta = \alpha\,p,$$

$\therefore$ power supplied to $A = m\,V\,I_{sc}\,\alpha\,p$ watts.

If R = speed of alternator in r.p.m.,
torque corresponding to the above power

$$= m\,V\,I_{sc}\,\alpha\,p \times \frac{33000}{746 \times 2\pi R} \text{ lbs.-feet.}$$

$$= \frac{7040\,p\,\alpha}{R} \times kVA \text{ on } S.C.$$

$$= \frac{422400\,f\,\alpha}{R^2} \times kVA \text{ on } S.C.$$

$$= (\text{say})\ k\,\alpha$$

Let $\Sigma m r^2$ = moment of inertia in lbs.-feet² of the whole moving system of *A*. Then torque due to the inertia of the moving parts

$$= -\frac{\Sigma m r^2}{g} \times \text{angular acceleration}$$

$$= -\frac{\Sigma m r^2}{g} \cdot \frac{d^2\alpha}{dt^2} \text{ lbs.-feet}$$

where g = acceleration due to gravity
= 32.2 feet/sec²

The negative sign is due to this torque opposing the accelerating torque due to the synchronising current.

Neglecting the torque due to currents induced in pole shoes, damping winding, etc., we have—

$$k\,\alpha = -\frac{\Sigma m r^2}{g} \cdot \frac{d^2\alpha}{dt^2}$$

$$\therefore \frac{d^2\alpha}{dt^2} + \frac{k\,g\,\alpha}{\Sigma m r^2} = 0$$

This is a differential equation of a well-known form and indicates that α is a periodic quantity. Also, the time of one complete oscillation is given by—

$$T = 2\pi \sqrt{\frac{\Sigma m r^2}{k\,g}} \text{ sec.}$$

$$= 0.0017\,R \sqrt{\frac{\Sigma m r^2}{f \times kVA \text{ on } S.C.}}$$

Applying the data given in question to this expression, we have—

$$\Sigma m r^2 = 250000 \text{ lbs.-feet}^2$$

---

* Books recommended are *Continuous Current Electrical Engineering* and *Alternating Current Electrical Engineering*, both by Maccall (each 15s. 6d., post free), and *Alternating Current Electrical Engineering*, by Kemp (17s. 6d., post free), from S. Rentell and Co., Ltd., 36, Maiden Lane, London, W.C.2.

and kVA on S.C. $= 3000 \times \frac{100}{20} = 15000$

since the synchronous reactance is given as 20 per cent.

$$\text{Hence } T = 0.0017 \times 1000 \sqrt{\frac{250000}{50 \times 15000}}$$
$$= 0.98 \text{ second.}$$

(*To be continued.*)

THE JUNIOR INSTITUTION OF ENGINEERS.

The 1924-25 session of the Junior Institution of Engineers will be opened on Friday October 3, at 7.30 p.m., with a lecture on "Explosions, Terrestrial and Celestial," by Prof. A. W. Bickerton, A.R.S.M. The chair will be taken by Prof. H. J. Spooner, M.I.Mech.E.

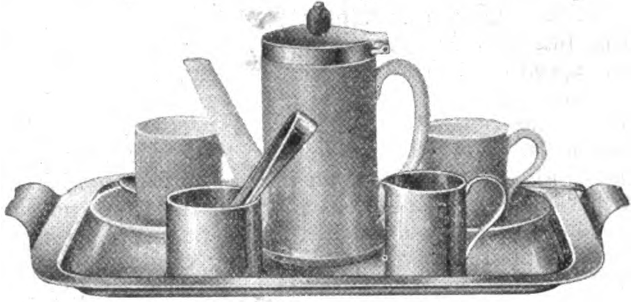
A full programme of papers and lecturettes has been prepared for the year, covering a variety of subjects of present-day interest. On October 10 a paper entitled "The Design of Static Sub-stations" will be read by N. Thornton, A.M.I.E.E. (Member), and on October 17, at a special meeting, a lecture on "High Voltage Electric Oscillations" will be delivered by R. P. Howgrave-Graham, M.I.E.E. Lecturettes to be delivered in October are "Powdered Fuel," by F. F. Evans (Member) on Friday the 24th, and "Audio-frequency Transformers," by H. J. N. Riddle (Assoc. Member) on Friday the 31st. The diary for October also includes two visits, one to a press-tool factory and another to an optical lens works.

Further particulars of these meetings and tickets of admission may be obtained from the Secretary, at 39, Victoria Street, S.W.1.

A "REAL" OSRAM BABY.

In this week's Current Topics reference is made to the electric carnival night which was held at the British Empire Exhibition, Wembley, on Wednesday, September 17, and that it included a procession of gaily decorated vehicles and walking models of electrical appliances, which started from the Faraday Gate and passed through the main avenues in the exhibition grounds. Among the electric vehicles the one illustrated herewith, representing the new Osram poster of the G.E.C., Ltd., was the winner of the first prize. The Osram baby was very ably represented by Miss E. Evans, late of the Royal Academy of Dramatic Art, and the electric vehicle was loaned from the well-known "Railodok" Co., whose plant was described in our issue of August 22 last. It was tastefully draped in blue and trimmed with multi-coloured streamers, while the car sides were decorated with Osram colour-sprayed lamps. In the interior of the car no fewer than 56 80 volt, 20 watt "White Osrams" and flame-tinted colour-sprayed lamps were used; the latter producing a distinct effect of warmth. In our illustration "The Osram Baby" is looking at a group of 28 "White Osrams"—a wonderful testimony to the glareless illumination of this lamp.

Our second illustration is of the prize awarded to Miss Davis, of Siemens and English Electric Lamp Co., Ltd., who represented a "Crystal Gazer" in the Electrical Fancy Costume Parade at the Dance Hall, and, prior to the dance, was in the Siemens decorated Railadok Car in the Carnival procession of Electric Vehicles. She was seated under a canopy at a table with a lighted Siemens white spray enamelled lamp, representing their new electric lamp showcard design which has recently been illustrated in our advertisement pages. The whole effect was very artistic, and she looked the part to perfection.



CHLORIDE EXHIBITS AT THE ALBERT HALL.

A very important exhibit at the All-British Wireless Exhibition now being held at the Albert Hall, London, is that of the Chloride Electrical Storage Co., Ltd., on Stand No. 73, where there is an array of batteries of all sizes, shapes and prices, from which the radio user can select a battery for every purpose. The small D.T.G. battery, in a glass box, with a capacity of 20 amp. hours for short intermittent discharges, and retailing at 5s., will specially interest the user of dull-emitter valves, while the B.K. and A.Y.G high-tension batteries giving the steady flow of current and constant voltage which cannot be obtained from dry batteries, are also worthy of notice.

The whole of the resources of the Chloride Co. are concentrated on manufacturing storage batteries only. It naturally follows that the batteries bearing their well-known "Exide" name are the last word in battery construction, and to the inquiring mind interested as much in what a battery is as in what it does, the various component parts of Exide batteries in various stages of construction will provide a field for study. As a matter of fact, a very large number of equipment makers standarise Exide batteries, and on this stand are shown batteries for Marconiphone, G.E.C., Elwell and other well-known sets.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of
CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N. 17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application, Subscription : 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL AND CO., LTD., 36-39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

Brain v. Brawn.

The proceedings of the special tribunal appointed to investigate the wages dispute in the electricity supply industry, together with the subsequent conclusions arrived at by that body, shed interesting light on what may be termed routine employment. The body of men concerned in this dispute, like other bodies following routine employment calling for little or no originality of thought or exceptional brain development, have come to rely upon mass activity for the improvement of their condition of life. In modern industry there are so many forms of occupation which are not strictly skilled, but comprise duties which can well be performed by any individual of average intelligence after a few hours' or days' practice and elementary instruction, that the individual performing those duties becomes in course of time a species of automaton or link in a huge machine made up of human components

Such occupations—and there are many of them—create discontent by virtue of their very monotony and the fact that they make no call upon the normal intelligence possessed by every individual who has passed through the average school training. As a result, the brain of the individual worker, left with insufficient to occupy it in the course of its daily duties, is tempted to embark on campaigns for securing an amelioration of the conditions of existence through the medium of collective bargaining with the so-called employers. The case of the railwaymen is similar; the guard, signalman, porter, and other recognised grades of railway employee have their daily routine duties to perform which ultimately become second nature to each individual by reason of their sameness and monotony There is nothing in these occupations to stimulate the inventive faculties or prompt the worker to original action, such as would justify his elevation to a more remunerative post.

On the other side of the scale we have the inevitable law of supply and demand operating to determine the maximum wage which such occupations can stand if they are to continue in being. Such industrial undertakings as electricity supply, railways, tramways, food distribution, and the like are essential services, for which, nevertheless, the public whom they serve can only afford to pay a certain maximum contribution. If that maximum be exceeded, due to increased wage demands on the part of the individual employees, the service becomes too expensive and beyond the reach of the average man in the street. As a result, demand falls off, and the particular industry stagnates, whilst the public, who have hitherto supported it, simply do without until prices come down again. It cannot be too generally understood by the wage-earner in a routine occupation that his remuneration constitutes the principal charge upon that undertaking, and, in consequence, has a very vital influence upon the prosperity of the undertaking, and, therefore, upon himself. It is a case of killing the goose to force up wages in a routine occupation beyond the economic limit.

It is an unfortunate result of modern industrial development that the man who has served an apprenticeship to a skilled trade or suffered inconvenience and low wages during his initiation into the mysteries of his craft should not be able to command better, if as good, wages as the unskilled worker in routine employment. It is one of the anomalies of the age that in certain districts a man willing to work can earn as much or more shifting dustbins or distributing tickets on a 'bus as he who has put in a five or ten years' training in a works as a fitter, instrument-maker, joiner, etc. If you set the former to assemble a motor-car engine, adjust a delicate voltmeter, make a kitchen table, or even solder a kettle which leaked, he would find himself in a quandary, yet he is able to command just as good and in some cases an even better wage for simply standing on the platform of a car and punching tickets, or maybe plying a broom in the street, if he be employed by a Labour-governed borough council. These are the anomalies that have arisen within the last decade, largely as an outcome of the war and its equality of service and opportunity without regard to birth or training, and they are fostered by the Socialistic doctrines of our Moscow extremists.

Carnival.

The Electric Carnival and Dance at the British Empire Exhibition last week was a great success. Appropriately enough, the winner in the costume parade was " Miss Electricity," a namesake of ours, whose general appearance was thoroughly deserving of the award. The participants in the parade had gone to considerable trouble and expense to captivate and please the crowd of observers; it is not an easy matter to " make up " as an electric iron, kettle, time-switch, wall-plug, or lamp, and great credit is due to those who worked so arduously to produce the carnival costumes and models which figured in the procession. The " Osram Baby " and the Siemens

Crystal Gazer" were well in evidence, while the subsequent gala dance at the Dance Hall was extremely successful and well attended, the ordinary dance programme being interspersed with fox-trot, balloon-bursting, and other competitions which attracted keen rivals in the art of terpsichore. The occasion was enhanced by the presence of many members of the I.M.E.A. who were visiting Wembley in connection with their autumn conference.

A Valuable Curio.

The value of an article is not always in the sum paid by the purchaser, but rather in the trouble and effort expended in securing it. It is on the latter score that I prize a possession which I have recently acquired, viz., a pass or visa into the B.E. Exhibition on Sunday. Bear in mind that the Exhibition precincts are taboo to the ordinary individual on the Sabbath, when it partakes of the nature of a forbidden city, to enter which one has to risk the disapproval of the military autocrats who stand guard over the invaluable exhibits collected together from all parts of the Empire. To obtain sanction for the entry of "one workman" into the sacred precincts of Wembley Park on the day of rest one has to practise the nearly forgotten arts of war-time when one wanted to do anything a little out of the ordinary as regulated by D.O.R.A. There are brigadier-generals, lieutenant-colonels, captains, and even humble subalterns to be propitiated, countless passages to traverse, and various stamps and hieroglyphics to be affixed to the finished document. However, I have secured that pass, and I am very proud of the achievement. If it had not to be given up on entry, I would most assuredly have it framed and mounted as a relic of the Great Exhibition of 1924. My one remaining ambition is to get a sight of the pass which admits the man who gives the monkey outside the Thibetan Theatre its Sunday dinner. As he has to enter the Holy of Holies *every* Sunday, that must be a very important document indeed.

The Procrastinators.

There are only a few weeks left in which to view the many wonders of Wembley before the greatest show on earth closes down. Already the attendances show a healthy upward tendency, especially on Saturdays, and from the local accent one hears it would appear that the Londoner is at long last realising the fact that Wembley Park is actually on his own doorstep and really worthy of his serious attention. During the past week I have welcomed at least ten Londoners doing the Exhibition for the first time; they one and all expressed the regret that they had not been earlier and made various excuses for the omission. However, now that the summer holiday season is over, the local residents will probably make up for lost time. The B.E. Exhibition is one of the "lions" that cannot justifiably be left to the sole enjoyment of "country cousins." For the benefit of those who are able to arrange for a visit on any ordinary week-day, I would add that the best days for the sightseer are Tuesdays, Thursdays, and Fridays, these being the days of comparatively small attendances when it is possible to perambulate the various pavilions and view the exhibits more closely than on the other popular days of crowded avenues.

That is by the way. I am convinced that there are large numbers of men and women who are directly engaged in our own electrical industry and resident within easy access of Wembley who have not yet visited the Exhibition, and all electrical manufacturers, contractors, and employers generally ought to make a point of sending their local clients, inquirers, and staff generally to see the wonders of the E.D.A. exhibit. It is doubtful if we shall see so comprehensive an electric display brought together for many years to come, and the slogan, "If it's Electric, you can see it at Wembley," is most energetically backed up by the E.D.A. assistants, who will most willingly guide interested readers through the various demonstrations which are given in the section under their charge. Therefore go, and go, and go again.

Wireless Wiring!

I have just read a newspaper report which is interesting from many points of view. It is an account of how a certain enterprising young gentleman found, for a time, a "soft" occupation in "obtaining money by a trick" (to quote the report). It all serves to show this remarkable fact: that the sharp practice of such individuals is only equalled by the gullibility of their victims. The trick in this case was an offer to small shopkeepers to instal electric light at a ridiculously low cost. A deposit was required, and, this obtained, the enterprising caller vanished—for good! Many tradesmen succumbed to the tempting offer, but at last the exploiter of electric light found himself in premises of an extremely inhospitable character. Here a severe and untrusting authority handed over six months' imprisonment instead of cash, and, although full board and lodging during our friend's holiday is being provided, there will be no undue compulsion *re* the matter of wiring-up the hotel. But this is merely due to the fact that electric lighting is already provided for the guests, albeit the lamps are mounted in a much less artistic and convenient fashion than is usual. However, there will probably be provision for the outlet of energy in some other way than wiring-up.

The newspaper report, as I said, is interesting in many ways. These are incidental, and I'm sure that the reporter himself would be quite in the dark as to the points that would tickle *us*. The headline runs as follows: "'Cheap' Electric Light." Why, the electric light wasn't even provided—let alone being cheap! The trickster is described as being 27 years of age and an electrical engineer, but it looks as if the latter is a self-assumed title, especially as the police described the prisoner as an *excellent mechanic* who could make a good living if he wished. But this post-war world of ours is very topsy-turvy. What standards of "good living" have we? Skilled engineers drawing about £2 17s. per week and the scavengers of some boroughs £4! One last comment. It appeared that at one shop visited by the "electrical engineer" the proprietor had no available cash resources, but, being a tobacconist, offered a box of cigarettes as deposit. This business-like offer was promptly accepted. All was grist that came to the mill!

ELEKTRON.

Many an old dog is willing to learn new tricks—but Mrs. Dog won't let him.

THE A.T.M. CO.'S EXHIBIT AT WEMBLEY.

The Automatic Telephone Mfg. Co.'s Stand in the Palace of Engineering is situated in Bays 14 and 15, Avenue 14, and contains interesting exhibits representative of the company's principal manufactures.

The various items on exhibition can be classified as follows:—

(1) Automatic telephone exchanges in operation shewing the latest developments in the Strowger director system for use in large metropolitan areas such as London.

(2) A demonstration working model of the Strowger automatic telephone system showing calls in progress between two subscribers.

(3) An exhibit of fast-speed telegraph apparatus featuring several of the company's developments in this type of equipment.

(4) A working step-by-step model designed and manufactured 40 years ago for automatically effecting connections between a group of subscribers and a distant exchange over a single trunk.

The Strowger automatic and manual telephone apparatus is arranged to represent a large exchange network introducing director equipment as now being manufactured for the British Post Office for London. The demonstration comprises representations of five exchanges which have been named and equipped as follows:—

(a) City exchange.—Automatic with director.

(b) Richmond exchange.—Automatic with director.

(c) Petersham exchange.—Automatic satellite to Richmond.

(d) Mechanical tandem exchange.—For junction working.

(e) Dalston exchange.—Manual with Coder call indicator.

The various classes of traffic which can be dealt with by the group of demonstration exchanges is briefly summarised below, and will afford an idea of the complexity of the switching operations involved and rendered simple by the introduction of the director.

(1) Manual to manual through mechanical tandem exchange.

(2) Manual to automatic with key-sending at mechanical tandem exchange.

(3) Automatic to automatic: direct dialling through local director. Subscribers in different exchanges.

(4) Automatic to automatic: direct dialling through director and mechanical tandem exchange.

(5) Automatic to manual with Coder call indicator at manual exchange.

(6) Automatic to automatic: direct dialling through local director. Subscribers in the same exchange.

Operation of the Director.

All the above exchanges are linked together by means of the director system, by which it is possible to co-ordinate all the telephone exchanges in a large metropolitan area in one comprehensive scheme combined with a uniform and standarised method of calling or dialling subscribers. One of the great advantages afforded by this system is that each exchange may retain its own individuality, *i.e.*, its name can be retained and the numbering scheme kept independent of any other exchange. Before the advent of the director the numbering scheme in a large automatic telephone exchange network required to be so arranged that it fitted in with the switching scheme of the whole system. From this the facility provided by the director will be readily apparent.

It will be of interest to describe briefly the method of dialling subscribers under this scheme. An illustration of the numbering of the dial is shown in Fig. 1,

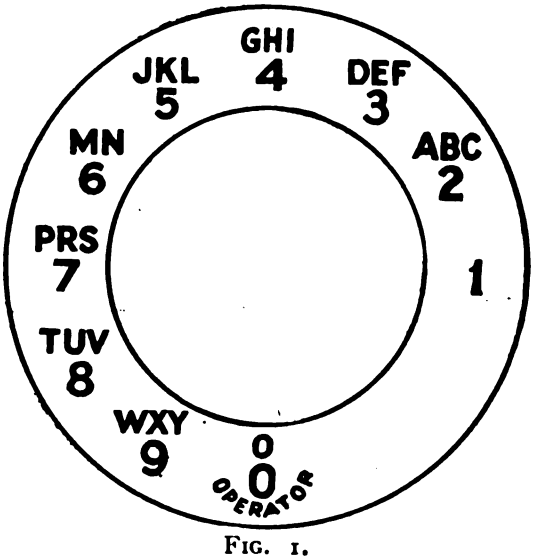


Fig. 1.

from which it will be seen that, in addition to the usual numbers "1 to 0," letters are introduced. To call a subscriber in the London area it will be necessary to dial the first three letters of the exchange name, together with the number, *e.g.*, BIShopsgate 2345 would be called by dialling BIS 2345, the whole combination being easily remembered. The function of the director switch is to translate the office code numerical equivalent (in the case of BIS this is 247) into the various steps required by the switching equipment to route the call to the required exchange in the network. After this the director transmits the numerical part usually consisting of four digits, and completes the selection of the required subscriber in the distant exchange. The remaining operations such as ringing, furnishing busy signal if line is engaged, switching through if line is available, metering of the call and instantaneous disconnection on hanging up the receivers are accomplished by the standard Strowger automatic methods. Fig. 2 illustrates a complete director unit with the cover removed.

The Mechanical Tandem Exchange.
(Represented by the Cordless "B" Position and Associated Automatic Switches.)

This important development, which will be employed in the London area, simplifies very greatly the difficulties met with in handling the large amount of junction traffic inherent to a metropolitan network, especially during the transition stage from manual to automatic working. For economic and financial reasons it is obviously impossible to convert at once all the telephone exchanges in the area to automatic working, and for a considerable period of time the network will be composed of both manual and automatic offices.

In addition to the cabling economies secured, the mechanical tandem exchange introduces automatic switches for completing the connections, which were hitherto performed manually, and effects operating economies by the elimination in many cases of one or more " B " operators previously required by junction working under the existing manual system. The connections are completed more rapidly, key-sending equipment is employed to set up the calls, and there is less chance of error in that for many cases one operator only at the mechanical tandem exchange is necessary to complete the junction between the manual subscriber and an automatic subscriber in the same network.

MANUAL EXCHANGE WITH CODER CALL INDICATOR.

In the network demonstration, " Dalston " represents a manual exchange with the usual " A " and " B " operators' positions. For exhibition purposes these are combined in one section (in ordinary circumstances they are, of course, dissociated). The method of operation in a manual exchange is well known and need not be detailed, but the manner in which calls are dealt with by the " B " operator is of interest.

Handling of the traffic is greatly facilitated by the introduction of the Coder call indicator system, which provides a device for displaying visually the digits comprising the number of the call required. These are set up automatically either by a subscriber at an automatic exchange dialling in the usual manner or through the medium of a cordless " B " operator at the mechanical tandem exchange.

So far as the automatic subscriber is concerned, the call to a manual subscriber is completely automatic. The manual subscriber secures a connection with the automatic exchange by giving the number as usual to the " A " operator in his local manual office. The

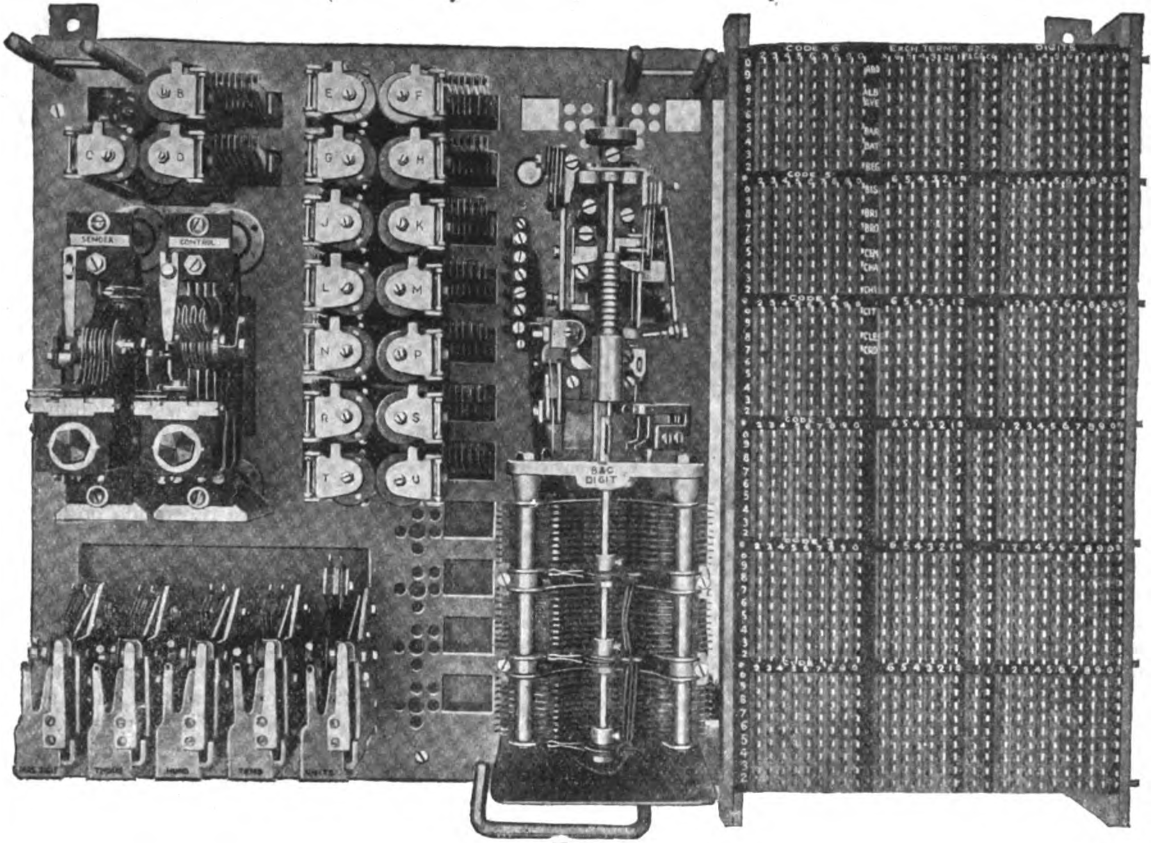


FIG. 2.

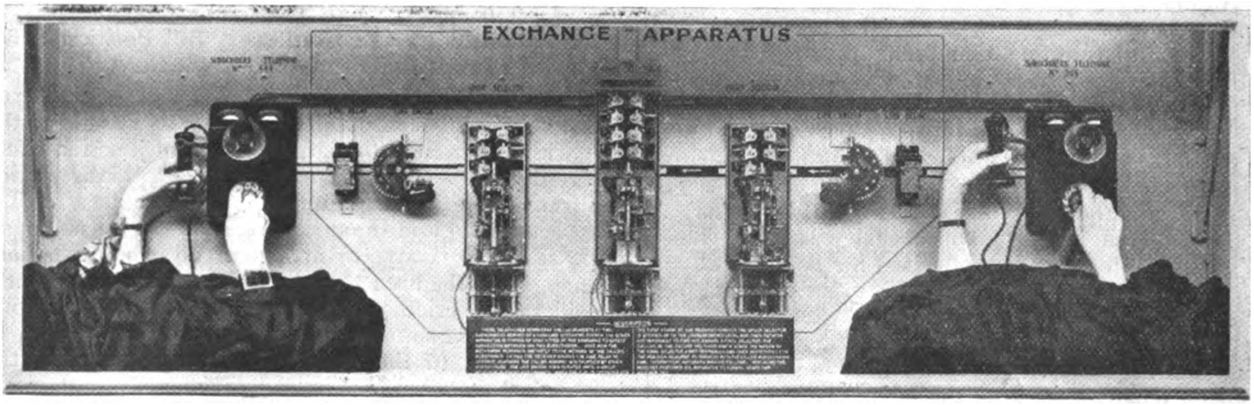


FIG. 3.

call is then routed via the cordless "B" operator at the mechanical tandem exchange to the distant automatic office.

DEMONSTRATION WORKING MODEL OF THE STROWGER AUTOMATIC TELEPHONE SYSTEM.

The demonstration working model which is illustrated in Fig. 3 comprises two automatic telephones and the switches used for completing connections at a 1,000-line Strowger exchange. Associated with the telephones are lifelike replicas of human hands and wrists, which by concealed mechanism are caused to lift the receiver and subsequently operate the dials of the telephones as in the act of calling a number. Each of the telephones is brought into action alternately, thus demonstrating calling in two directions. Following the conventional movement of the hands the exchange mechanism responds step by step as in actual practice. The procedure of the call is graphically illustrated by means of coloured arrows, which automatically come into view and indicate the extension of the call step by step.

TELEGRAPH EXHIBIT.

The telegraph display represents two high-speed duplex land stations working through a repeater office. Features of interest are the A.T.M. simplified Wheatstone transmitters and receivers, undulators and Palmer keys. Working demonstrations are given by arrangement.

WORKING MODEL OF AN EARLY FORM OF AUTOMATIC TRUNKING SWITCH.

This exhibit is of considerable historical interest in that it shows a very early form of automatic trunking, which was devised some forty years ago by Messrs. Sinclair and Corbett and installed at Coatbridge and elsewhere by the National Telephone Company in the 'eighties. The model is arranged to effect automatic trunking between any one of a group of six subscribers' stations and a distant exchange, the circuits being of the early type, viz., single line and earth return.

Only one line connects the switch, which is located at a convenient centre in the group and the distant exchange. The system is capable of trunking in both directions. The impulses necessary for working the switch are produced by the depression of a key the requisite number of times. This key is equivalent to the present calling dial. The method of operation is as follows:—

(*a*) On a call being made to the exchange from any one of the group of subscribers, the switch is engaged and the remainder of the group are automatically excluded from using the junction. The subscriber making the call secures the junction, and the operator at the exchange completes the connection in the usual manner through the multiple.

(*b*) When the operator at the exchange wishes to call any one of the group of subscribers she actuates the distant switch by sending the required number of impulses along the junction line by means of a key. The switch steps to the wanted line completing the connection to the subscriber and at the same time disconnecting the remainder of the group and preventing them from interfering with the call while it is in progress. A subscriber is called by the exchange operator and the call is switched through. After conversation the clearing of the line is effected by the exchange operator sending the further impulses required to actuate the switch to the completion of its cycle, when its release is automatically effected, thus leaving the exchange line available for further calls.

At the present time the apparatus is of historical interest only, having been superseded by more efficient and satisfactory methods of trunking; but it is a remarkable piece of mechanism, considering the state of the telephone art at the time, and serves to demonstrate one of the many stages in the development of Strowger automatic telephony.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 188.

I have under my charge a large number of mercury motor-meters for overhauling and calibration. I would like some details as to how I can clean mercury with acid and subsequently distill it in vacuo. Any other method of purifying mercury will be helpful. I have been sending the mercury to Johannesburg to a chemist, but I wish to do the cleaning myself.—JOHN J. WUD, Witenhage, C.P. South Africa.

QUESTION NO. 189.

Can you give me a reliable method of adjusting the ordinary microphone transmitter (carbon) fitted to magneto ringing telephones fitted with induction coils in a private exchange?—"MAGNETO."

(Replies to Questions Nos. 188 and 189 must be received not later than September 27, 1924.)

Meetings.—A meeting of the Birmingham Electric Club will be held at the Grand Hotel, Colmore Row, to-night, Friday, September 26, at 7 p.m., when Mr. W. N. Y. King, A.C.G.I., A.M.I.E.E., will give a lecture on "Electric Motors for Special Purposes," illustrated by lantern slides——The next meeting of the Diesel Engine Users' Association is to be held on Friday, October 3, at the Engineers' Club, Coventry Street, W.1, when a paper by Mr. P. H. Smith on "The Significance of Exhaust Temperature" is to be read and discussed. Non-members interested in the subject and desirous of attending the meeting can make application for tickets of admission to Mr. Percy Still, joint hon. sec., at 19, Cadogan Gdns., London, S.W.3.——The Inst. of Railway Signal Engineers will meet on October 1 at 6.30 p.m. at the I.E.E., Victoria Embankment, London, when an open discussion will take place on "The Possibilities of Railway Signalling from an Economic Point of View."

ELECTRIC PASSENGER LIFTS.*

By H. MARRYAT (Member).

(Continued from page 498.)

I have said that, given the necessary particulars of a building, the lift engineer will be able to calculate the probable traffic. It must be admitted, however, that the lift engineer himself does not usually employ any scientific method in arriving at the number of passengers per minute which will require lift service on each particular floor during the busy part of the day. Each will draw upon his own experience and home-made formulæ. If these could be collated, the general advantage would be served and many mistakes avoided.

Some interesting figures derived from American practice are given in a paper by Mr. Harrison P. Reed, from which we learn that in New York City from 65 to 100 sq. ft. of rentable floor space is the average allowance per person occupying an office building. In other cities the allowance should be increased to 150 sq. ft. per person, and it is estimated that a lift service should be provided to empty such buildings above the first floor in from 40 to 60 minutes. It is, however, doubtful if American figures of this description apply to this country. The only English pronouncement that I can find is contained in a paper read recently by Mr. C. H. I. Day before the Association of Engineers-in-Charge, in which he says—referring to a large office building—that the average density of population is about 120 sq. ft. of floor space for each occupant, but when one or two large firms occupy a whole building the population is almost certain to be denser than this, amounting perhaps to as much as 80 sq. ft. of floor space per person.

In the absence of any definite information on this point, Mr. Day says that it is considered safe to assume about 110 sq. ft. per person as a fair average. He also says that in buildings where tests have been made, the rate of traffic flow at the busiest time of the day has been found to be such as to include the equivalent of the entire population of the building in 45 minutes, and that the passenger traffic can be predetermined by allowing for a period of rush from 15 to 20 minutes, during which time a number equal to one-third of the population of the building is dealt with.

Figures derived from my own observation are not in agreement with this, but I must confess that although I have been investigating the subject for some considerable time I have not yet amassed sufficient data to permit of my making an authoritative pronouncement. The means adopted in this investigation may be of interest and may possibly lead to the suggestion of better methods in the course of discussion.

In the first place the buildings in which lifts are usually installed have been divided into a large number of classes, and each class has been separately examined under conditions which, I believe, apply to that particular class. For instance, in large drapery establishments and multiple-store buildings I count the number of persons per minute proceeding from the ground floor to upper floors. In office buildings of the class usually sub-let to a large number of different tenants I take no notice of persons arriving at or departing from the basement, ground floor or first floor, but make the count upon the second floor of all persons arriving at, passing, or departing from that floor. In office buildings in which several or all the floors are occupied by the same tenant—an insurance office, for instance—I count the number of persons arriving at and departing from each floor, so as to check the inter-floor traffic; and in buildings where there is a restaurant on one of the floors a separate census is taken of the number of persons arriving at and departing from the restaurant, in order to check the special traffic so created. In taking this census of traffic in existing occupied buildings, I have at the outset been faced with the fact that existing lift accommodation is, in almost every instance, insufficient. It has been necessary, therefore, to count not only persons using the lifts, but also those using the staircases.

For the present I will confine myself to a few examples to indicate the nature of the results obtained. In each case the figures have been reduced to per 1,000 sq. ft. of rental floor space served by the lifts.

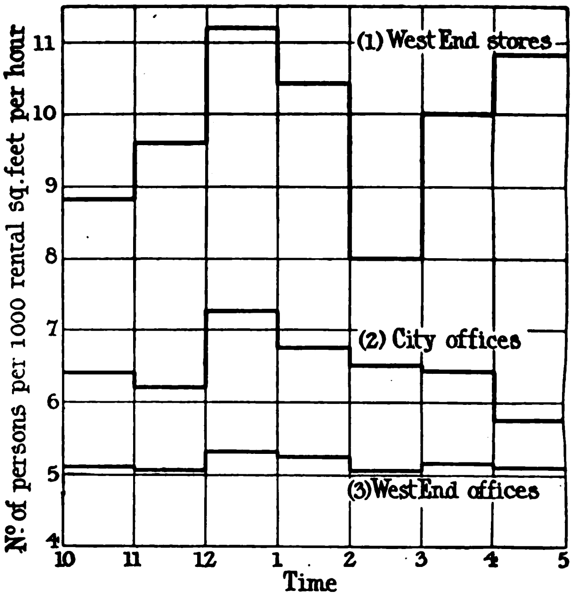


FIG. 1.

In Fig. 1, curve (1) represents the average traffic counted in a group of West End drapery establishments. In each case the number of persons proceeding per hour from the ground floor to any other floor has been counted, and the curve represents the average of all establishments examined. Curve (2) represents a similar average deduced from a count taken in a large

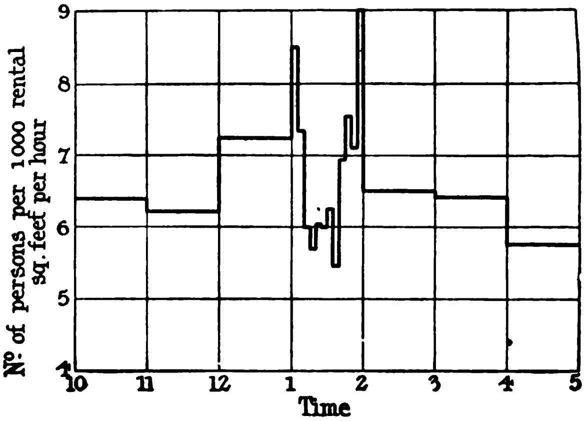


FIG. 2.

---

* Paper read before the Institution of Electrical Engineers.

group of City office buildings of the class in which the floors are sub-let to a variety of tenants. The curve indicates the number of persons per hour who arrive at or pass the second floor. In order to obtain a more accurate estimate of the period between 1 o'clock and 2 o'clock mid-day, the more detailed curves shown in Fig. 2 were prepared. The third example in Fig. 1 comprises a similar group of offices situated in the West End of London. The different characteristics are strikingly shown. In this case there is no "rush" period, so that, in order to provide the same lift facilities for the same population, less lift capacity is required.

To arrive with more accuracy at the lift capacity required for a City (London) office building of the class usually sub-let to a variety of tenants, we refer again to Fig. 1, from which it will be observed that the largest amount of traffic occurs between noon and 1 p.m. As the effect of the dinner-hour traffic is not clearly indicated, it was decided to take detailed observations over the whole period from 11.30 a.m. to 2.30 p.m., in order to arrive at the true maximum traffic requirements on the building.

(To be continued.)

ELECTRICAL INSTALLATION WORK.

By C. SYLVESTER, A.M.I.E.E., A.M.I.Mech.E.

Solutions to the Questions in Grade I. C. & G. Examination on May 6th, 1924.

(Continued from page 506.)

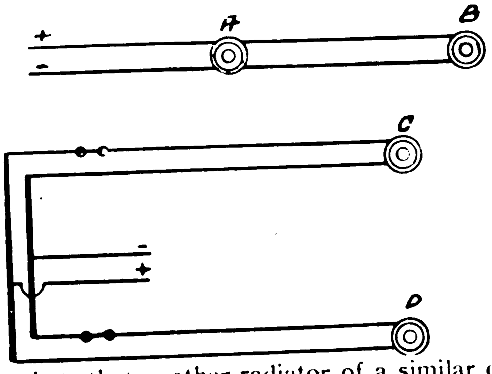
Question 4.—A consumer has his house already wired and fitted for electric light at 200 volts; the wall sockets, which are used for portable table standards, being of 5-ampere size. He inquires of you whether he can use a 200 volt 1-kilowatt radiator at any one of the wall sockets. What would be your answer? Give your reasons for it.

The answer is "yes."

The reasons for it is that the amount of current through the wall sockets will not exceed, when a 1-kilowatt radiator is connected to it, 5 amperes. One kilowatt is equal to 1,000 watts and, since watts is the product of volts × amperes, the current will be:—

$$\frac{1{,}000}{200} = 5 \text{ amperes.}$$

It does not follow, however, that because one radiator of 1-kilowatt capacity can be connected to one wall socket, that another radiator of a similar capacity may be connected to another wall socket in the same room; the governing factor here is the size of the wire with which the circuits are wired.



For instance, see sketch, let us assume that two wall sockets, A and B, are supplied with current from one pair of mains. It is obvious that if two radiators were connected to the supply the wires between the first radiator and the supply would be carrying twice the amount of current as is flowing in the remainder of the circuit; the capacity of this wire, therefore, should be twice that of the other.

It is possible that the wall sockets are connected up as shown at C and D. If this is the case, and it would be so if each wall socket is connected to its own fuse, then the wire throughout the system would be of the same capacity, that is to carry 5 amperes, since this amount of current would not be exceeded.

(To be continued.)

Trade Notes.

A well-printed booklet dealing with the advantages and future of concrete in connection with the important question of housing has been issued by the directors of the **Concrete Utilities Bureau**, of 35, Gt. St. Helens, London, E.C.3, from whom copies may be obtained on application. It shows the enormous amount of good work which has been carried out at Wembley by means of concrete, and should certainly interest all architects and builders, as well as everyone who is faced with the present housing problem.

List No. 77a has been issued by the **Hewittic Electric Co., Ltd.**, London. It gives illustrations and descriptions of the latest types of Hewittic Mercury Vapour Rectifiers, as manufactured by the company at their works, and will, therefore, appeal to every central station engineer, to whom copies will willingly be sent on application. It is claimed that these rectifiers are extensively employed for semi-automatic substation equipments, and are also admirably suited for totally automatic operation, principally due to the fact that the rectifier is a static plant. The control is simple; consequently only a limited number of relays are required.

An interesting leaflet, which has just been published by **Messrs. Vickers**, of Vickers House, Broadway, London, S.W.1, describes the exhibits in the Vickers research building in the Palace of Engineering. These represent various novel instruments and machines, and we can cordially recommend them to the attention of our readers, more particularly those who are associated in any way with testing and laboratory work. A copy of the leaflet will be willingly sent to any reader on application.

We have received from the **Italian Commissioner of the Federation of British Industries** a splendidly illustrated catalogue entitled "Veni-Vd-Vici," and dealing in an interesting and illustrative manner with the V. and D. refractory bricks, the sale of which is controlled and promoted in Italy by Signor Giuseppe Verzoschi, of Milan. The catalogue is really a work of art, and we hope that it will have the result of pushing the trade in these bricks and material, and also that it will set an example which will be copied by many other English firms who are anxious to promote British export trade.

A useful postcard circular has been issued by **Messrs. King's Patent Agency, Ltd.**, 146a, Queen Victoria Street, London, E.C.4, showing clearly on a neat map the position of their office in relation to St. Paul's and the adjacent stations, so that clients who wish to call can find their way without any difficulty.

A new catalogue of Arora Electrical Fires has just been issued by the **Arora Company**, of Loughborough, and the trade are certain to appreciate the new types of fires which Mr. Grogan has prepared for the season 1924-25. In order to increase the popularity of the cast iron types, a heat-resisting handle is now supplied on all these fires without extra charge, and the feet are of cast-iron, while new types of sheet-metal fires, namely, the "Wembley" and "Empire," have been introduced. New curved types of bars have been adopted in various directions, and altogether the list is one which should be of assistance to all contractors and dealers who wish to push an article which may be looked upon as absolutely reliable. Copies will be willingly sent on receipt of the usual trade application.

The **Pluto Stoker Co.**, of 2, Upper Westbourne Terrace, London, W.2, are issuing some literature and blue prints dealing with the Pluto Suspended Arch, which can be fitted to any type of boiler, furnace or industrial oven in connection with mechanical or hand-fired grates, pulverised fuel installations, and gas or oil-fired plants. It should, therefore, prove of direct interest to all central station engineers, and to readers who may be in charge of steam generators.

The Maxlume catalogue No. 961, which has just been issued by **Messrs. Veritys, Ltd.**, of Plume Works, Aston, Birmingham, contains details of the various Maxlume fittings and reflectors, and as such will be of direct interest to the trade in general and electrical contractors in particular. It also contains a preliminary announcement in regard to the Maxlume electric bowl fire, which is shortly to be placed on the market, and for which the makers claim an attractive appearance combined with high efficiency.

Booklet No. 146, issued by the **New Pelapone Engine Co., Ltd.**, of Dewsbury, Yorks, gives prices and particulars of their new "F" four-cycle paraffin-driven electric generating plants, which have been designed to meet the demand for a robust and reliable engine of moderate speed suitable for electric lighting and pumping as well as for general estate purposes. The list, therefore, should be of direct interest to contractors who specialise in this class of work for country houses, farms and outlying installations generally.

The **Edison Swan Electric Co., Ltd.**, 123-5, Queen Victoria Street, E.C.4, have sent us a copy of their new Industrial Lighting Catalogue. The catalogue deals with: Lighting data, R.L.M. lighting equipment, reflector fittings, outside lanterns, shop lighting material and accessories. The catalogue contains a great deal of information and is well illustrated. A copy will be sent to persons interested if application is made to the Edison Swan Company.

The **Metropolitan-Vickers Electrical Co., Ltd.**, of Trafford Park, Manchester, have just issued Small Motor List No. 10/03, which gives illustrations and details of the Metrovick Utility Motor. This is a small H.P. motor, which has the same dimensions irrespective of the circuit on which it is run, and should, therefore, prove extremely useful to manufacturers of machines and appliances requiring a small power to drive them, as they have then only one type of drive to consider in designing the supporting brackets, etc., and can be sure that the motor can be supplied suitably wound for any required commercial voltage or periodicity. The fact that all parts are made to jig, and are interchangeable, is also a useful feature when renewals or repairs are required.

Wireless in Italy.—A confidential report on the development of wireless in Italy has been prepared by the Department of Overseas Trade, and United Kingdom firms desirous of receiving a copy with full particulars of the Special Register service and form of application for registration should communicate with the D.O.T., 35, Old Queen St., London, S.W.1.

Quotations Wanted.—The N.S.W. Govt. Rys. Dept. at Sydney are calling for tenders for four motor generator sets.——Also, the Chief Electrical Engineer's Branch of the same Dept. is calling for tenders for lighting, storage and switch-operating batteries.——The Town Council at Beaufort West, Cape Province, are calling for tenders to be presented by October 31, for power-station plant for their electric lighting scheme. Specifications, etc., at the D.O.T. (Room 52), 35, Old Queen St., London, S.W.1.

The scheme prepared by Messrs. Barry, Wolfe Barry and Messent for the supply of electricity in the Settlement and Cantonment of Aden has been adopted. High-pressure three-phase alternating current will be generated at 6,600 volts, 50 cycles, and will be transformed down for the supply to consumers in the shape of three-phase four-wire alternating current at 230 volts per phase. The maximum charges to consumers which are permissible under the licence are: (1) For general supply purposes for lights, fans and heaters, 6 annas a unit; (2) power purposes, 4 annas a unit, with a minimum monthly charge in each case of Rs. 3-8-0 per month. The tender of Messrs. Cromptons, Ltd., for the power-house and its plant has been accepted by the Executive Committee. It provides for three Vickers-Spearing boilers and three 250 kw. Allen-Crompton turbo alternators, together with the necessary subsidiary machinery. It is hoped that the plant will be in operation by September, 1925.

Various Items.

Practical Electrical Engineering Hints.—Owing to pressure on our space the above is held over this week, but readers are asked to send them along just the same. They are attracting much attention.

Removal.—Mr. F. B. O. Hawes, A.M.I.C.E., M.I.E.E., hon. sec., informs us that on and after Monday, the 29th inst., the offices of the Electrical Trades Benevolent Institution will be moved to 98, Grosvenor Road, S.W.1.

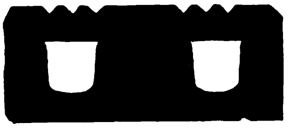
New Session.—On Monday, September 29, and Tuesday, September 30 (10 a.m. to 1 p.m.), students of the Faculty of Engineering of the University of London, University College, will be received by the Provost, the Dean of the Faculty and the Sub-Dean. The new engineering laboratories, provided by the gifts of old students and friends of the College and with the help of the L.C.C., are now available.

Egypt.—A report on the economic and financial situation of Egypt has just been issued by the Dept. of Overseas Trade, and shows the present healthy condition of the State finances. It should be interesting to electrical engineers and the trade from the description given of the electrical works at present in the course of construction for the Government, as well as particulars of trade generally. The price of the report is 1s. 7d. post free from H.M. Stationery Office, or from the office of this paper.

Trade with South Africa.—Mr. W. G. Wickham, Senior Trade Commissioner in South Africa, is at present in this country, and will be in attendance at the Department of Overseas Trade during October for the purpose of interviewing British manufacturers and merchants interested in export trade to South Africa. Such interviews will only be by appointment, and applications, quoting reference 5457 T.G., should be addressed to the Comptroller-General, D.O.T., 35, Old Queen St., Westminster, S.W.1.

"**How to Drive a Car.**"—The popular handbook, "How to Drive a Car" (Temple Press, 2s. 6d. net), by the Editor of the *Motor*, now in its eighth edition, has been entirely rewritten and reillustrated. Car-driving has become more of an art requiring skill, sound judgment and rapid decisions than in the days of the earlier editions of this handbook. There is vastly more traffic on the roads, and road congestion, consequently road risks have greatly increased. The new edition describes in the simplest non-technical terms the correct and most efficient and safe methods of handling a car, no previous knowledge of the subject being assumed. The instruction is progressive in the form of 12 chapters, and numerous illustrations assist in rendering the text clear. Altogether, it is a remarkably comprehensive and thoroughly up-to-date handbook on the art of car-driving, embodying all the subtleties and finer points of it. It is indispensable to the beginner in motoring, and even the experienced hand at driving will find much valuable information in it.

ARMATURE REPAIRS
MARRYAT & PLACE.
28, HATTON GARDEN,
LONDON, E.C.1.



CASING AND CAPPING.
BLOCKS, CLEATS,
BOARDS FOR SWITCHES
In stock and made to any design.
ACCUMULATOR CASES
and BATTERY BOXES
Made to Order.
J. F. & G. HARRIS, Ltd.,
Timber Merchants and Moulding Manufacturers,
SAWING, PLANING, MOULDING & GENERAL WOODWORKING MILLS
58g, WILSON ST., FINSBURY, LONDON, E.C.
Telephone No: 1168 London Wall. Please write for Illustrated Price List.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

OCTOBER 3, 1924.

CONTENTS.

	PAGE
A Hundred Years of Electrical Engineering	525
Testing a New Ironclad Switch	526
Electrical Engineering—Grade I.	527
Heating and Ventilating	528
A New "Underfeed" Stoker	528
Current Topics	531
Questions and Answers by Practical Men	532
Electrical Installation Work	533
An Important New Zealand Contract	533
Electric Passenger Lifts	534
The Otis King's Calculator	536
Practical Electrical Engineering Hints	537
An Interesting Test	538
Various Items	540

A HUNDRED YEARS OF ELECTRICAL ENGINEERING.*

This Section of the British Association, over which I have the honour to preside, is concerned with the whole field of engineering, civil, mechanical and electrical. Within recent years the great developments which have taken place in each of these branches have necessarily led to a high degree of specialisation, with the result that a man may have an expert knowledge of one branch but a very slight knowledge of the other branches; in fact, the scope of a single branch is now so extensive and the amount of research work being done so great that it is impossible to keep abreast of the developments in one's own special subject unless one concentrates upon it to a degree that leaves little leisure for cultivating other branches of engineering. These considerations influenced my choice of a subject for this Presidential Address. As an electrical engineer, I felt that I should be expected to deal with some branch of electrical engineering—indeed, I should not feel competent to discuss any other branch—but, in view of the facts to which I have referred, I decided not to deal in detail with any single section of the subject, but to review the past development and present position of the subject as a whole.

The time for such a review is opportune. William Thomson, afterwards Lord Kelvin, the only man who has ever been elected three times (in 1874, 1889, 1907) President of the Institution of Electrical Engineers, was born on June 26, 1824. He was closely associated with the British Association, and for sixty years took an important part in the meetings. He was President of the Association at the Edinburgh meeting in 1871, and was several times president of Section A. I wonder what the members of the organising committee of Section G would think if the President, in addition to reading his address, offered to contribute twelve papers to the Proceedings of the Section: this is what Kelvin did as president of Section A at the Glasgow meeting in 1876. I can find no record of his taking any part in the proceedings of Section G, although his brother, James Thomson, was president of the Section at the Belfast meeting in 1874.

If any one event can be regarded as the birth of electrical engineering, it is surely the discovery by Faraday in 1821 of the principle of the electro-motor; that is, that a conductor carrying a current in a magnetic field experiences a force tending to move it. It is noteworthy that ten years elapsed before Faraday discovered, in 1831, magneto-electric induction; that i.e., the principle of the dynamo. Four years later, Sturgeon added the commutator or "uniodirective discharger," as he called it, and in 1845 Cooke and Wheatstone used electomagnets, which Sturgeon had discovered in 1825, instead of permanent magnets. It was during the years 1865-1873 that the shunt and series self-excited dynamo, using a ring or drum armature and a commutator of many segments, finally evolved.

The early workers in the field do not appear to have realised the intimate connection between the dynamo and the motor, for, although the principle was discovered by Lenz in 1838, it only appears to have become generally known that the same machine could be used for either purpose about 1850. The principle underlying the whole modern development of electrical engineering—viz., the generation of electrical power by a dynamo, its transmission to a distant point, and its retransformation to mechanical power by an electromotor—appears to have evolved about 1873. An interesting light is thrown on the subject by a paper read before the Institution of Civil Engineers in 1857 by Mr. Hunt, on "Electromagnetism as a Motive Power." In this paper the possibility of driving electromagnetic engines—that is, electric motors—by currents derived from voltaic batteries was discussed in the light of Jacobi's discovery of the bac-electromotive force in these machines. He concluded that power so generated would be sixty times as dear as steam power, and that it would be far more economical to burn the zinc under a boiler than to consume it in a battery for generating electromagnetic power. The leading scientists and engineers who took part in the debate all agreed that electromotive power was unpractical and impossible commercially. William Thomson sent a contribution in writing which concluded with the following sentence: "Until some mode is found for producing electricity as many times cheaper than that of an ordinary galvanic battery, as coal is cheaper than zinc, electromagnetic engines cannot supersede the steam engine." As S. P. Thompson says: "Faraday's great discovery of 1831 notwithstanding, the real significance of the dynamo had not yet (in 1857) dawned upon the keenest minds of the time." Six years before this, Thomson had suggested the experiment of driving a "galvanic engine" from a thermal battery, and had stated the problem in terms which show that he already had a correct grasp of the theory of the efficiency of the electric motor.

It was at the Manchester meeting of the British Association in 1861 that Charles Bright and Latimer Clark read a paper proposing names for the principal electrical units; the names were "galvat" for current, "ohma" for electromotive force, "farad" for quantity, and "volt" for resistance. This paper led to the appointment of the celebrated Electrical Standards Committee of the British Association, which, after six years of strenuous work, produced the system now adopted internationally.

---

* Address before the British Association, at Toronto, by Professor G. W. O. Howe, D.Sc., President of Section G.—Engineering.

One of the earliest applications of the dynamo was for lighting arc lamps in lighthouses; in 1863 Thomson, writing to a friend on the relative merits of the Holmes direct-current and the Nollet alternating-current lighthouse machines, says: "Thus Nollet escapes the commutator, *a great evil*, and gets a flame which does not burn one of the points faster than the other. The reverse of each proposition applies to Holmes. *The commutator is a frightful thing* . . . the thing to be done at the requisite speed is appalling. However, Holmes does it successfully. But I believe it cannot be done except theoretically without great waste of energy and consequent burning of contact surfaces. . . . *But I believe a large voltaic battery will be more economical than any electromagnetic machine.* I am not quite confident about this, but shall be so soon, as I am getting a large voltaic, and I shall soon learn how expensive its habits are, and multiply by the number required for a lighthouse." This was thirty-two years after Faraday had discovered the principle of the dynamo.

In after years Kelvin lost his dread of the commutator and championed direct against alternating current on every possible occasion. In 1879, when giving evidence before a Select Committee of the House of Commons on Electric Light, he even assured them that there would be no danger of terrible effects from the employment of electric power, because the currents would be continuous and not alternating!

The fifteen years following 1863 saw a great development of the dynamo, and in 1878, when a paper was read before the Institution of Civil Engineers on the improvements introduced by Siemens, Thomson made a remark, following a suggestion by Dr. C. W. Siemens, that showed that he had by this time thoroughly grasped the possibilities. He said that he believed that with an exceedingly moderate amount of copper it would be possible to carry the electrical energy for one hundred or two hundred or one thousand electric lights to a distance of several hundred miles. Dr. Siemens had mentioned to him that the power of the Falls of Niagara might be transmitted electrically to a distance, and he need not point out the vast economy to be obtained by the use of such a fall as that of Niagara or the employment of waste coal at the pit's mouth. In his evidence before the Select Committee referred to above he gave an estimate of the copper required to transmit 21,000 horse-power from Niagara to a distance of 300 miles.

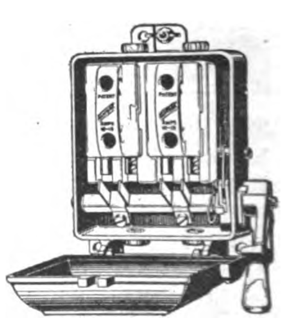
In 1881 Thomson returned to the subject in his Presidential Address to Section A at York and said: "High potential, as Siemens, I believe, first pointed out, is the essential for good dynamical economy in the electric transmission of power." He mentioned 80,000 volts as a suitable voltage. In a paper before the Section he developed the now well-known Kelvin Law of the most economical cross-section of the conductor. In 1890 the American promoters of the project for utilising the power of Niagara turned to Thomson for his advice, and he became a member of the Commission of Experts. He was throughout stubbornly opposed to the use of alternating currents; he wrote: "I have no doubt in my own mind but that the high-pressure direct-current system is greatly to be preferred to alternating currents. The fascinating character of the mathematical problems and experimental illustrations presented by the alternating-current system and the facilities which it presents for the distribution of electric light through sparsely populated districts have, I think, tended to lead astray even engineers, who ought to be insensible to everything except estimates of economy and utility." He was in a hopeless minority, however, in this view, and the Falls of Niagara were harnessed to two-phase alternators with an output of 3,500 kilowatts each. Kelvin was present at the meeting of the British Association held in this city in 1897, and shocked many people by saying that he looked forward to the time when the whole water of Lake Erie would find its way to the lower level of Lake Ontario through machinery; "I do not hope," he said, "that our children's children will ever see the Niagara Cataract." Although he was apparently very much impressed with the success of the Niagara system, he was not converted from his allegiance to direct currents, for at his last appearance at the Institution of Electrical Engineers, in 1907, he said: "I have never swerved from the opinion that the right system for long-distance transmission of power by electricity is the direct-current system."

The development of the dynamo during the 'seventies and the simultaneous development of the incandescent lamp led to the general introduction of electric light during the 'eighties. Attempts to make incandescent electric lamps had been made as early as 1841, when de Moleyns patented one having a spiral platinum filament, and in 1847 Grove illuminated the lecture theatre of the Royal Institution with such lamps, the source of power being primary batteries; but it was not until 1878 that the commercial development of the incandescent electric lamp was begun by Edison and Swan.

(*To be continued.*)

TESTING A NEW IRONCLAD SWITCH.

The Midland Electric Manufacturing Co., Ltd., who are ever to the fore in the way of sound switches and switchgear, have just introduced a new member of their celebrated "M.E.M." family, which has been named "Memette," and of which a sample is now before us as we write. As the name implies, it is particularly small and neat (see illustration), the full measurements being 6 in. by 4¾ in. by 2¾ in. The rating is 15 amperes 250 volts, but this by no means represents the limits of its performance.


THE MEMETTE IRONCLAD SWITCH.

As a matter of fact, when on test recently at Birmingham University Electrical Laboratory, some excellent results were obtained. To start with, the fuses were heavily wired and the switch connected to a 250 volt circuit with the same pressure between live parts and case. It was then operated about 200 times with currents rising from 15 to 200 amperes, 10 times to each rating. On the final rating the switch broke the 200 amps. at 250 volts satisfactorily, and as there were practical difficulties in applying heavier loads, the switch was not broken down.

The same switch was then tested at higher voltages and broke equally satisfactorily 25 amps. at 375 volts and 15 amps. at 440 volts.

The fuses were then wired with standard fuse wire (26 s.w.g. tinned copper) and the circuit was adjusted to take the current of 45 amperes; the fuse cleared the circuit without damage to fuse or switch. The fuses were then rewired and short-circuited across the terminals of a 250 volt 500 ampere-hour battery, and broke circuit quite satisfactorily. It was then returned to the company's works, and there mechanically operated at full load and voltage for over 4,000 complete movements, after which the fuses were heavily wired and the switch was left in circuit until a final temperature was reached, when it showed a rise of 26 deg. F., the British Standards Specification allowing 36 deg. F. The switch was then subjected to a 2,500 volt flash test and showed no fault, and a further test on a "Megger" registered infinity.

It has been the aim of the manufacturers to design and produce a combination switch and fuse of absolute reliability, suitable for small-house service and industrial work. At the same time, the appearance is such that it makes a special appeal for domestic work, where a coupled tumbler switch is not sufficiently robust and where the usual ironclad switch was a little unwieldy. The quick make-and-break action renders it proof against folly or ignorance, while we are informed the price is so low that the appeal must be nearly universal.

The manufacturers, The Midland Electric Mfg. Co., Ltd., Barford Street, Birmingham, will be pleased to send full particulars of the new switch to any of our readers on request.

ELECTRICAL ENGINEERING—GRADE I.*

Solutions to 1924 *Examination Questions of the City and Guilds Institute.*

BY EDWARD HUGHES, B.Sc. (Eng.), A.M.I.E.E.

(*Continued from page* 509.)

Q. 3.—A hot-water heater has three similar resistance elements arranged for high, medium and low heating. Show how the three elements would be arranged to give the most uniform variation in the three stages, stating the relative values of heating thus obtained. (Ignore effect of temperature on resistance.)

A. 3.—The three resistance elements can be arranged in the following combinations :—

(*a*) All in series.

(*b*) Two in series, the third element being out of circuit.

(*c*) Two in parallel in series with the third element.

(*d*) One element only.

(*e*) Two elements in series in parallel with the third element.

(*f*) Two in parallel, the third element being out of circuit.

(*g*) Three in parallel.

Let us consider the relative amounts of heat generated with the above combinations.

Suppose R to be the resistance of each element, and V to be the supply voltage.

With arrangement (*a*) total resistance $= 3R$.

$$\therefore \text{current} = \frac{V}{3R}$$

$$\text{and heat generated} = \frac{V^2}{3R} \text{ watts.}$$

$$\text{With } (b), \text{total resistance} = 2R, \therefore \text{heat generated} = \frac{V^2}{2R}$$

$$\text{,,}\ (c),\ \text{,,}\ \text{,,} = \frac{3}{2}R, \therefore\ \text{,,}\ \text{,,} = \frac{2V^2}{3R}$$

$$\text{,,}\ (d),\ \text{,,}\ \text{,,} = \text{R}, \therefore\ \text{,,}\ \text{,,} = \frac{V^2}{R}$$

$$\text{,,}\ (e),\ \text{,,}\ \text{,,} = \frac{2R}{3}, \therefore\ \text{,,}\ \text{,,} = \frac{3V^2}{2R}$$

$$\text{,,}\ (f),\ \text{,,}\ \text{,,} = \frac{R}{2}, \therefore\ \text{,,}\ \text{,,} = \frac{2V^2}{R}$$

$$\text{,,}\ (g),\ \text{,,}\ \text{,,} = \frac{R}{3}, \therefore\ \text{,,}\ \text{,,} = \frac{3V^2}{R}$$

Since V^2/R is common to all the expressions for the heat generated, the relative values are given by :—

$$a:b:c:d:e:f:g = \tfrac{1}{3} : \tfrac{1}{2} : \tfrac{2}{3} : 1 : \tfrac{3}{2} : 2 :: 3$$
$$= 2:3:4:6:9:12:18.$$

By adopting (*a*), (*e*) and (*g*), we have the most uniform variation, since the heat generated with combination (*e*) is approximately mid-way between the amounts generated with (*a*) and (*g*) respectively. These three combinations can be obtained by means of two series-parallel switches S_1 and S_2 (Fig. 1) placed one above the other and coupled by a rod C (Fig. 2) having a slot at its lower end.

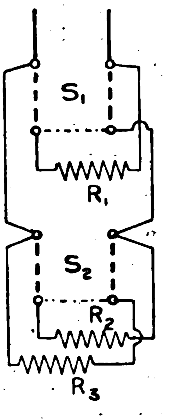


FIG. 1.

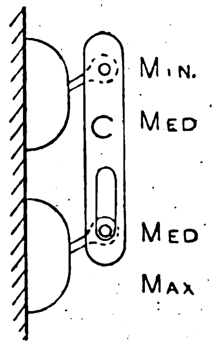


FIG. 2.

When both switches are up, the connections are indicated by the chain-dotted lines in Fig. 1, the three resistance elements being in series. By depressing S_1, its connections are changed to those shown by the thick-dotted lines, so that R_1 is placed directly across the supply. Owing to the slot at the lower end of C, S_2

---

* Books recommended are *Elements of Electrotechnics*, by Young (7s. 10d. post free), and *Technical Electricity*, by Davidge and Hutchinson (13s post free), both from S. Rentell and Co., Ltd., 36, Maiden Lane, London, W.C.2.

remains unaffected, R_2 and R_3 being therefore still in series but connected across the supply by S_1.

By depressing S_2 we put R_2 and R_3 in parallel; and since S_2 cannot be depressed without S_1 being also depressed, the three elements must be in parallel across the supply, and the maximum amount of heat is therefore obtained.

(*To be continued.*)

HEATING AND VENTILATING.

A competition was arranged by the Inst. of Heating and Ventilating Engineers early in the year to encourage education in the industry, and the result has now been issued by the council. Interest seems to have been awakened in different parts of the world, and the "Lumby" Premium, £10 10s., presented by Messrs. Lumby's, Ltd., of Halifax, was secured by an American, Mr. V. Nekrassoff, of Philadelphia, U.S.A. The "Sirocco" Premium, £10 10s., presented by Messrs. Davidson and Co., Ltd., Belfast, was awarded to Mr. Victor Matthews, of Bristol, and the "Preston" Premium, £5 5s., presented by Mr. J. R. Preston, of Messrs. Mumford Bailey and Preston, Ltd., London, was awarded to Mr. H. A. Stirzaker, of London. Let us hope that in the near future the Institution will be able to award a premium presented by some firm which is directly associated with heating by electricity. There should be ample scope for some good papers.

A NEW "UNDERFEED" STOKER.

During only the past four or five years very remarkable improvements have been made in the technique of mechanical stokers as applied to water-tube boilers, partly because of the formidable competition of pulverised fuel. Our readers in charge of steam-raising plant will therefore be interested in a new stoker, the "Underfeed Type C," the design of which embodies many novel features, which has just been put on the market by Messrs. The Underfeed Stoker Co., Ltd. Essentially it is a laminated steel belt travelling grate stoker composed of excessively narrow steel links, so that riddlings are claimed to be almost entirely eliminated, not only with ordinary quality steam coals, but even with refuse material in a fine state of division, whilst at the same time the use of links of this description without burning out is rendered possible by the new and ingenious device of water cooling the entire grate. Riddlings have, of course, always been one of the most serious defects of the ordinary chain grate and similar types of stoker, amounting in some cases to 30 per cent. of the weight of the coal, because of the necessity of using relatively heavy cast-iron links, which means, of course, large air spaces in order to get sufficient volume through the total grate area. In this new stoker the links are thin, flat segments or stampings of steel only ¼ inch wide, so that the air supply is divided up to an extent hitherto regarded as impossible, and as already indicated, it is claimed that refuse fuels in a fine state of division, such as anthracite and coke breeze dust, can be burnt, a highly important achievement.

There are many other new details of design in this stoker; for example, the drive is a fluted drum engaging every link in the full width of the laminated belt which hangs down loose underneath travelling completely submerged in a long water bath extending the full length of the stoker. This not only cools the links and prevents undue wear and tear, but at the same time quenches the ash at the end of the travel, the steam formed prevents the aggregation of clinker and the water acts as a seal for the air supply, which is on the efficient adjustable "compartmented" principle, although the stoker is specially intended for natural or induced draught. This also is a new adaptation of the controlled air supply at every stage of the grate length, whilst the grate is not flat as in the usual travelling grate types, but rises upwards towards the centre of the fire, is then flat for a considerable distance, and finally falls again for the remainder of the length. This results in a thick layer of ash at the end of the travel, which acts as a seal and still further prevents excess air passing at this point. Finally, the design of the thin steel links is such as to ensure expansion and contraction of the entire chain surface equally divided through every link. The stoker, by means of the "Detrick" suspended fire-brick arch, can be constructed in single units up to 24 ft. in width, while the "guillotine" coal feed device from the hopper is never entirely closed, so that a slice bar may be put through into the fire at all times and any link can be replaced whilst the stoker is running.

THE MARCONI DIRECTION FINDER ON AMERICAN VESSELS.

The United American liner *Reliance*, which arrived at Southampton on the 24th ult., is to be equipped with a Marconi wireless direction finder. The range of the instrument is 100 miles without correction, and it covers all wave-lengths from 400 metres to 1,000 metres. This ensures that accurate bearings can be taken with maximum efficiency over all the wave-lengths used in maritime signalling. Most of the signalling between ships, and between shore and ships, is on 600 metres wave-length, and the transmission of special signals by beacon stations is usually on 1,000 metres, so that the Marconi direction-finder is as suitable for assistance to navigation in open waters as it is when making landfall. It is of interest to note that the s.s. *Cleveland*, of the same line, already carries Marconi direction-finding equipment, and the navigation of the ship has been greatly assisted by the excellent results obtained therefrom.

Removal.—The offices and stores of L. E. Wilson and Co. electrical engineers, have been transferred to 62a, Mosley Street, Manchester. Telephone: City 344. Telegrams: "Telephony."

Tenders Accepted.—The Southern Railway have accepted the tender of the G.E.C. for six months' supplies of Osram metal filament vacuum and gasfilled lamps, also for Robertson carbon filament lamps.——The Admiralty have accepted the tender of the Edison Swan Electric Co., Ltd., for the supply of lampholders and insulators.

"**Use Electricity.**"—This is the title of a neatly illustrated and thoroughly descriptive 32-pp. booklet which has just been issued by the Boston and District Electric Supply Co., Ltd. It is intended for circulation among their clients and possible clients, and from the attractive way in which it is printed, and the explanations which are given dealing with the multiple advantages of electricity in its applications to home and business purposes, it should most certainly prove a very good advert. and lead to a considerable increase in the demand for the current which the company are so anxious to supply. We wish them the best of good fortune in their enterprise.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of
CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N. 17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half-year, 3s. 8d. a quarter in advance, postage prepaid in the United Kingdom and abraod.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited, and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL & CO., LTD., 36-39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

Durability a Fetish?

The modern progress of evolution and development in engineering, and especially the electrical branches, is so rapid, that the question arises whether the time-worn British slogan, "Built to Last," should not be considerably modified in its application, at all events, to certain plant and apparatus. During the past century we have cultivated the habit of pointing with justifiable pride to certain obsolete yet workworthy engines, dynamos, locomotives, and, in short, machinery of varied kinds and functions, and commenting on the excellent wearing qualities of these fine old "British" products. Other and younger countries have long realised the advantages of designing on the basis of immediate efficiency and short life, making for cheaper production costs and justifiable "scrapping" of the product as soon as something better is available. So rapid is development nowadays that the "something better" is very frequently available on the heels of the original product, and the resultant gain in efficiency is secured at a much less sacrifice than if the existing machine had been built to last.

The effect of rapid development upon durability in design is well exemplified in the motor-car world, where design has marched so rapidly during the quarter of a century that a very large proportion of cars now on the road are either obsolete or obsolescent judged by the standards of 1924. The same thing holds good in almost every phase of the industry, and is particularly vital in its effect upon generating plant and machinery. There are comparatively few power stations in this country to-day which are really up to date as disclosed by the recently published report of the Electricity Commissioners, and the large percentage of obsolete plant still in active commission has a very important influence on the ruling prices at which electrical energy is dispensed to the consumer. Admittedly, we should not rush to the opposite extreme and sacrifice reliability as exemplified in typical British plant turned out by the leading firms, but it would appear abundantly necessary to revise our traditional ideas concerning durability and finish when designing modern plant and machinery, and take into account the length of time it is likely to remain economically serviceable.

Electricity in Service.

That the unremitting efforts of the E.D.A. staff at Wembley have not been unfruitful was brought home to me by an incident last week. A lady who had been watching the demonstrations of electric washing, ironing, cooking, etc., told me that she had recently become the tenant of a house in a certain London suburb where "juice" is fortunately available at a reasonable figure, and proposed to equip her house throughout with electrical labour-saving devices. She was most enthusiastic on the subject, and put forward a few suggestions for the detail improvement of certain appliances based on her own experience of domestic duties. That is the right spirit to have cultivated in the mind of at least one of the many thousands who have visited the E.D.A. exhibits. We not only want to inculcate the "Electricity in Service" spirit, but we also want the housewife to come forward with her views on the merits or otherwise of the appliances we place at her disposal. Very often these appliances are designed and developed purely from the standpoint of the electrical engineer and manufacturer, and with little or no regard to the opinions of the ladies who will ultimately buy and use them.

As an example of this lady's enterprise she informed me that among other items she had recently purchased an electric vacuum cleaner. As the appliance in question was rather beyond her intended expenditure on this particular section of the domestic equipment she had instituted a hiring-out scheme among her immediate neighbours, who thus enjoyed the privileges of electrical dust and dirt removal in their respective homes on payment of a nominal weekly rental. On this basis the original outlay on the machine would soon be recouped. The idea is quite a sound one, and might well be extended to other of the well-known domestic electrical appliances which are only in occasional use, and the comparatively high cost of which militates against their more general adoption. Thus, an electric washing machine could be jointly purchased by some six householders, used for the weekly wash by each family in turn, and would thus amply justify the initial outlay, besides earning a liberal revenue on the capital investment.

Our Food Supply.

A casual paragraph in the daily Press, appearing concurrently with a most interesting article, "Power and Food," in our contemporary, the *Electrical Times*, prompts the reflection that with all our strenuous industrial activity of to-day we pay far too little regard to the vital subject of food production, which we are all too apt to take for granted.

Sir Henry Thornton, President of the Canadian National Railways, recently stated that the day was not far distant when the United States would not be exporting wheat, but would be dependent on Canada for its main supply of staple foodstuffs. Considered in its bearing on the future well-being of this and other countries whose populations are increasing by leaps and bounds, and which depend largely upon Canadian wheat supplies for their daily bread, this authoritative statement reveals a state of affairs not immediately alarming, but which may well become so in the course of a comparatively short space of time.

Already we are largely dependent upon our Colonies overseas for our principal food supplies, and if the demands of other countries have to be met, in addition to our own ever growing requirements, there may well come a time when those Colonies will find their resources taxed to the utmost, unless some artificial means are employed to increase and hasten production. Among such means electroculture, the use of artificial fertilisers, etc., have already been tried to a certain extent, but on a comparatively small scale, and it is questionable whether the accumulated experience so far gained is sufficient to justify the hope that this principle of crop stimulation will solve the problem which threatens to confront future generations.

Writing in the *Electrical Times* Mr. Henry M. Sayers puts forward another novel suggestion for increasing vegetable growth by making use of the waste heat from the cooling water after leaving the condensers at large power stations. In this connection it is not generally appreciated that the most efficient steam-driven generating stations actually waste three-quarters of the heat value of the fuel burnt, in the circulating water which has passed through the condensers. There is no development in sight which promises to reduce this heat loss by more than a small and negligible fraction. It has to be recognised that at present, and for such future as can be forecast, a very large volume of warm water is a by-product of the most economical generating plant available.

The waste heat circulating water has an average temperature of about 90 deg. F., or about 40 deg. F. above the mean air temperature in this country, and Mr. Sayer's proposal is to make use of it by means of a network of pipes laid just below the soil, or alternatively by open ditches and connecting channels cut through cultivated land in the immediate vicinity of the power stations. His theory, based on practical observation and a certain amount of experiment, is that the soil thus artificially warmed would be more favourable to the rapid growth of certain crops than similar soil at ordinary temperatures, and that winter growth might be stimulated and a new crop rotation evolved. The suggestion is admittedly novel, and as such calls for considerable experiment and research to determine its practical possibilities and the added cost of application. In any event, it would appear well worth trying, and the important link between engineering and agriculture in its bearing on the world's food supply of the future might conceivably justify an entirely new field of research, making for the ultimate benefit of this and other wheat-consuming countries.

Elektron.

Questions and Answers by Practical Men.

RULES.

Questions: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

Answers: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

Question No. 190.

I desire to find a fault on an underground cable. Are there other tests, other than Murray's loop test, which may be applied? If so, I would appreciate practical and technical details.—"D. Williams."

(*Replies to Question No.* 190 *must be received not later than October* 25, 1924.)

Answers to Questions.

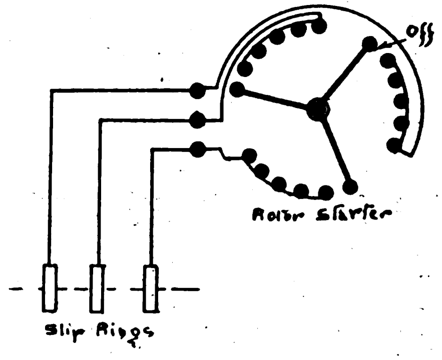
Question No. 183.

I have an intermittent rating motor starter of 50 h.p., 440 volts, 50 cycles. This starter is contained in a cast-iron case which is filled with oil. From tests I have carried out, I find that an open circuit exists between two contacts. How can I best remedy this defect? What precautions should I take with regard to the oil, etc.?—"Astatic."

Replies to Question No. 183.

The first prize (10s.) has been awarded to "E. M. F." for the following reply:—

No doubt the motor to which "Astatic" refers is a three-phase slip-ring induction motor, and the starter is a rheostat controlling the rotor circuit. The rotor will most probably have a three-phase winding, but it should be remembered that in some cases the rotor of a three-phase motor has a two-phase winding. Let us consider the motor with a three-phase rotor first. The starter will have three resistance banks connected in star via the contact arms, the connection diagram



being as per the above sketch, which shows the rotor starter and slip-rings only.

An inspection of the diagram will show that when everything is sound there must be a circuit between any two adjacent studs. When an open circuit exists between adjacent studs, either :—

(*a*) the conductor between one of the studs and the resistance elements is broken, or

(*b*) the resistance itself has a broken circuit.

For (*a*) the remedy is obvious.

For (*b*) a new section of resistance must be put in to take the place of the faulty section. It must, of course, be equal in ohmic value and current carrying capacity to what was originally provided. It is usual for the three banks of resistance which make up the complete starter to be identical, therefore the size and length of wire can easily be determined by examining the resistance in one of the sound phases between corresponding studs.

If the resistance is built up of cast or stamped iron grids, some new grids must be obtained from the manufacturer of the starter, and, in ordering, either the identification number stamped on each grid should be quoted, or else the serial number of the starter, and the position of the studs between which the open circuit exists should be quoted. This is essential because sometimes the grids are not identical in size through the whole length of the resistance.

It is not necessary to keep the starter out of service until the resistance materials are obtained. A temporary repair can be made by bridging the studs affected with a copper strap. Such a temporary measure should not be left in circuit longer than necessary, because it causes unbalanced rotor currents to circulate, which may give rise to serious overheating in the rotor winding, especially if a heavy starting torque has to be exerted, or the service demands frequent starting.

If the rotor has a two-phase winding precisely similar measures should be adopted as described in the foregoing, but the starter will only have two banks of resistance instead of three.

The oil should be good-class oil, such as is used for transformers. It should be examined periodically, say, about every three months, for sediment which will settle at the bottom of the tank. When the sediment becomes very pronounced the oil should be changed and the tank cleaned, but the intervals between which changing becomes necessary will vary with the duty. If there is reason to suspect moisture in the oil it must be carefully dried out by heating, but the oil must not be allowed to boil. Moisture is sometimes present in oil which has been long in stock.

The correct level of oil must always be maintained, and most starters are provided with means of indicating such level. At any rate, all contacts and resistance elements must be completely submerged. Some starters have the contacts at the bottom of the tank and others have them at the top. When they are at the top especial care must be taken to see that they are always completely submerged, otherwise when the oil level falls, there is a danger of sparking taking place in oil vapour and a dangerous explosion resulting.

"E. M. F."

The Second Prize Winner's reply will be published in due course.

The best thing for a fool and his money is to be soon parted, for then both the fool and the money usually go to work.

ELECTRICAL INSTALLATION WORK.

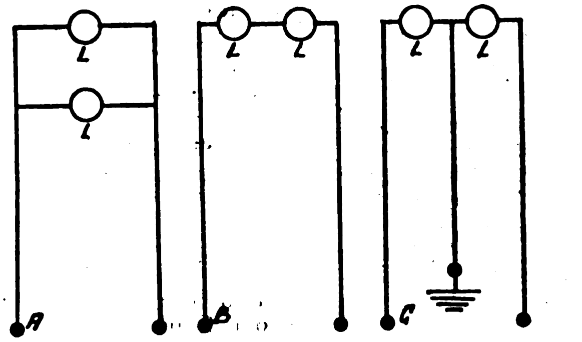
By C. SYLVESTER, A.M.I.E.E., A.M.I.Mech.E.

Solutions to the Questions in Grade I. C. & G. Examination on May 6th, 1924.

(*Continued from page* 523.)

QUESTION 5.—Make clear and neat diagrams showing incandescent lamps (*a*) in parallel, (*b*) in series, (*c*) on a three-wire distribution.

In the diagrams below, A, B and C indicate lamps in parallel, in series and on a three-wire distribution respectively; L in each case is the lamps.



The conditions at A are usual in lighting installations, the inconvenience of the conditions shown at B being that, if one lamp burns out, both lamps are extinguished.

Referring to C, it will be seen that the lamps between one outer and neutral, and the neutral and other outer, are in series. In this case, if the whole of the lamps on one side were to fail, the lamps on the other side would be extinguished. It is not likely, however, that this would occur, precautions being taken to balance the load and so maintain stability.

(*To be continued.*)

AN IMPORTANT NEW ZEALAND CONTRACT.

In connection with the extensions which are now taking place at the Lake Coleridge Hydro-Electric Power Station of the New Zealand Government, it is interesting to note that Messrs. Bruce Peebles and Co., Ltd., Edinburgh, have been successful in securing the contract for the supply of the two 7,500-kw. alternators, each complete with direct coupled exciter. They will be designed to operate at .85 power factor, and to generate a three-phase 50-cycle current at a pressure of 6,600/7,000 volts when driven at a normal speed of 500 r.p.m. They will be of the totally enclosed forced ventilated type, the cooling air being provided by an induction motor-driven fan, which is also to be supplied by the firm. There will be two main bearings of the forced lubricated type, the oil pump being driven by belt from the main shaft, and the machines will be designed to withstand a runaway speed of 90 per cent. above normal.

The contract includes the supply of oil tanks and strainers, oil coolers with water tanks, as well as all apparatus necessary for the successful operation of the plant, and it is of interest to note that Messrs. Bruce Peebles supplied the original generating plant, which has been in successful operation for many years.

ELECTRIC PASSENGER LIFTS.*

By H. MARRYAT (Member).

(*Continued from page* 523.)

Eleven office blocks comprising both large and small buildings were selected. In every case care was taken to watch not only all lifts but all staircases simultaneously. A count was made upon the second floor of every person arriving at, departing from, or passing that floor in each direction. The result of this count has been carefully reduced to persons per hour per 1,000 sq. ft. of rental floor area above the first floor. The observations were recorded at the end of every minute, and plotted for each separate building in the series of curves shown, the average of which is given in Fig. 3. Some interesting things may be learnt from this figure. It will be noticed at once that the traffic is inclined to move in bunches, and that had the observations been taken over 2-minute intervals the curve would have been very different in form. A curve has been prepared to illustrate this, and shows clearly the errors likely to arise from taking a count over any period longer than 1 minute, as it is the maximum traffic and not the average with which the lift engineer has to deal.

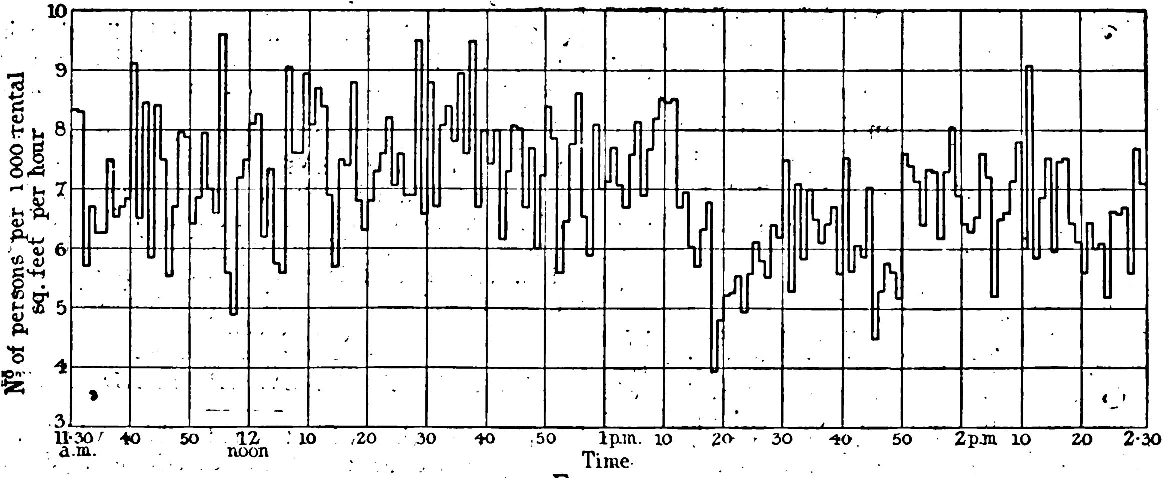


FIG. 3.

Referring to Fig. 3, we find that the average traffic per hour per unit of floor space taken during the period 11.30 a.m. to 2.30 p.m. is approximately 6.98, and between 12.10 p.m. and 1.10 p.m., 7.5. If, however, provision is made for the average traffic only, it is obvious that many people will either wait for several minutes for lift service or use the stairs in preference.

It may be considered unnecessary to provide accommodation calculated upon a maximum traffic which may only occur during a single minute of the day, but in this connection it must be remembered that this curve itself is an average of 11 typical buildings, and that the maximum of 9.6 must be compared with the maximum of over 20, shown for a 1-minute period on three of the individual buildings. It is reasonable, therefore, to provide for the maximum indicated in Fig. 3.

The effect of providing a lesser lift service may be gauged by reference to Table 1, which gives figures for City (London) office buildings.

TABLE 1.

Lift capacity in persons per hour per 1,000 sq. ft. rental floor area above first floor	Number of minutes during the day when lift capacity will be insufficient
7	84
7·5	56
8	33
8·5	14
9	5
9·5	1

Assuming that we allow for a lift capacity of 9.6 persons per hour per 1,000 sq. ft. of rental floor area above the first floor in the class of building specified, and taking the New York allowance of 65 to 100 sq. ft. of rental floor space per inhabitant—say, 82.5 sq. ft.—the lift capacity at which we have arrived would allow for the emptying of the building above the first floor in 1 hr. 15 min., a figure which, it will be noted, differs altogether from those arrived at by American authorities and by Mr. Day, but which is, I believe, when applied to buildings in the City of London, a more accurate one.

In order, then, to discover the lift capacity in such a building, the following formula may be used:—

$$\frac{9.6A}{NL}$$

where A = thousands of sq. ft. rental floor area above the first floor;
N = number of circular trips, including stoppages, which can be made per lift per hour; and
L = number of lifts.

Having discovered the total lift capacity required, it is next necessary to decide the number of lifts to be employed and their speed.

As about 30 seconds represents the limit of patience to be expected of the average City man waiting for a lift, a building cannot be considered to be adequately served when the occupants or visitors are asked to wait longer. To calculate the number of lifts required to handle a given traffic and give a half-minute service, the overall speed of the lifts—allowing for all stoppages—must be known. The number of stoppages a lift

---

* Paper read before the Institution of Electrical Engineers.

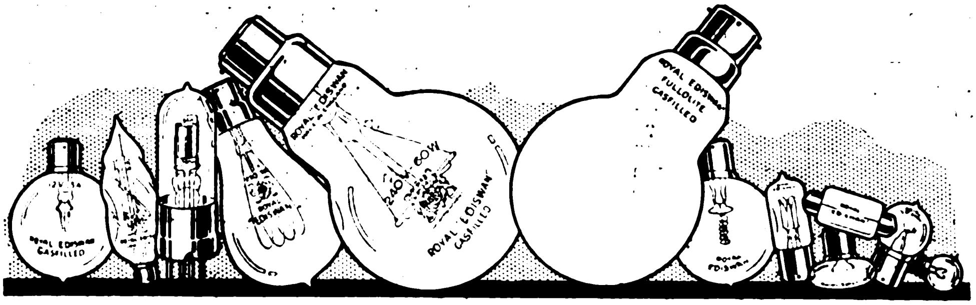
GET
Increased Sales
"FROM ROYAL
EDISWAN
LAMPS"

ROYAL EDISWAN LAMPS offer exceptional advantages to the dealer for increasing sales and building goodwill. For more than half a century the name of "Ediswan" on *any* lamp has been a guarantee of Economy, Strength and Reliability. Your customers have confidence in "Ediswan" and every lamp you sell will bring repeat orders and increase your own reputation.

Tell the public you sell and recommend "Ediswan" Lamps. Once their economy and reliability has been tested you will find a ready and rapidly increasing demand for them.

The new "Ediswan" Catalogue will be sent free on request. Write also for details of "Ediswan" overprinted literature and attractive showcards. Don't delay. Write now to

THE EDISON SWAN ELECTRIC CO., LTD.,
123-125, Queen Victoria Street, London, E.C.4.
Works: Ponders End, Middlesex.



may be required to make in the course of a return journey from the ground floor and back again varies considerably, but in the class of building which we have been considering, it is found to average about one stop for every 42 ft. of running. Allowing 12 seconds per stop for loss in acceleration, deceleration, opening and closing of gates and for the time taken by the passengers in entering and leaving the car, together with a further allowance to cover general loss of time, we find that the overall time in seconds required for the circular trip will be:—

$$\frac{60\times 2T}{R}+\frac{2T\times 12}{42}$$

where R = running speed of lift in feet per min.,
T = total travel of lift in feet in one direction.

In the case of a lift with 100 ft. travel and a running speed of 200 ft. per min., the overall time for the circular journey will be 117 seconds. In such a City office building two lifts of given capacity might not provide the required service, whereas three would more than do so, but by slightly increasing the speed the two lifts would suffice.

It will be observed that I make an allowance of 12 seconds for stoppage and lost time in an all-round average service. This will only be found sufficient provided the car is not too large. If the capacity is more than 10 persons—including attendant—the time allowance and the total lift capacity must be increased accordingly. It must also be assumed that the lifts are suitably situated and designed with wide openings for the easy ingress and egress of passengers. Under such conditions the effect of running speed upon overall speed may be set out as in Table 2 for a lift of 100 ft. travel.

TABLE 2.

Running speed	Overall time per circular trip with 100 ft. travel
ft. per min.	secs.
100	177
200	117
300	97
400	87
500	81
600	77

It will be observed that the saving in overall running time falls off as the running speed is increased, so there must come a point at which additional capital cost is not justified by the saving in time. In Table 3, approximate figures are given in order to indicate the relation of running speed to capital cost for a lift designed for a load of 10 persons.

TABLE 3.

Running speed	Extra cost (approx.) of machinery and safety devices (July 1923)
ft. per min.	£
60	—
100	25
200	75
400	150
500	190
600	220

The figures do not represent a large percentage upon the cost of a lift of the travel and capacity we have been considering, and, when taken in conjunction with a consideration of the saving of rent and attendance, will generally work out in favour of the higher-speed lift.

It has been maintained that lifts of a speed of over 250 ft. per min. cannot be justified in this country because of the lesser height of our buildings as compared with those in America, and that the period of acceleration and deceleration occupies practically the whole time of the short average journey so that there is no opportunity for the lift to run at its full designed speed. The objection is a sound one and is supported by the practice of making the acceleration and deceleration periods long, in the belief that it is necessary to do so if the internal economy of passengers is not to be upset. Nevertheless, as ground space is of so great a value in large cities the importance of designing a lift which will accelerate and decelerate quickly, and so permit advantage to be taken of higher speeds, will be appreciated.

(To be continued.)

THE OTIS KING'S CALCULATOR.

This patent calculator affords a simple means of solving rapidly and accurately almost every kind of calculation dealt with by professional and business men. Multiplication, division, proportion, percentages, including both simple and compound factors, are all done by just a simple operation. Previous experience in the use of mathematical instruments is not necessary.

For calculations involving a constant factor (such as basis prices, the conversion of lbs. to kilos, foreign currencies to sterling, and *vice versa*) the calculator is of exceptional value. The one factor is repeated throughout a series of problems; the instrument may be set to the constant term, and the answer to each problem found by one movement of the indicator only.

The Otis King's Calculator consists of two metal tubes, the smaller (cylinder) being free to rotate and slide within the larger (holder). Spiral scales are mounted on each of these tubes, while a third tube mounted on the holder forms a tubular cursor, or indicator, carrying at each end an engraved arrow, which can be set to any mark, or to which any mark can be set.

The three parts of the instrument are inseparable, and, being made of metal throughout, there is no possibility of their warping or being affected in any other way by climatic conditions. The instrument, in fact, is practically indestructible, a point of considerable importance to the engineer who goes abroad.

The scales are produced photographically on a special material, which has an extremely hard waterproof surface. The size of the instrument fully extended is 10 in. by 1⅛ in.; and closed 6 in. by 1⅛ in. The scales on the calculator are 66 in. long, with a correspondingly high degree of accuracy.

This instrument has been carefully tested and is one that should be of immense value to the student or practical man who requires something that will stand rough usage and yet be an instrument to be relied upon for accuracy.

Removal.—Messrs. Harper and Bros., the publishers, announce that their new address is 35, Great Russell Street, W.C.1. Telephone: Museum 6466. Telegrams: "Harpspel," Westcent, London.

Practical Electrical Engineering Hints.

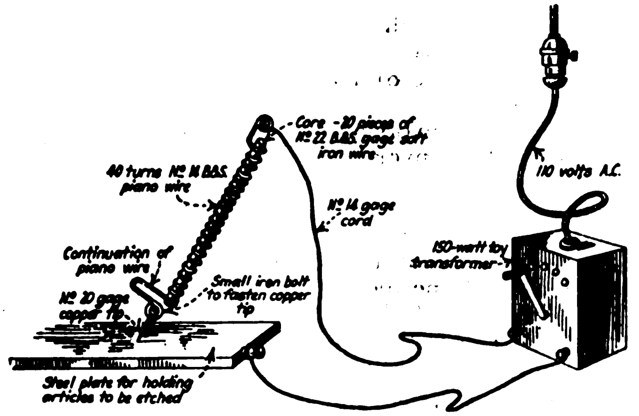
We cordially invite all our readers to contribute to this interesting and useful feature. All hints received will be given careful consideration and will be paid for at our usual rates.—The Editor.

No. 12.—How an Inexpensive Etching Pencil was Made.

An etching pencil is very useful for marking tools, dies, instruments and other metal objects. I made one that is simple in construction, and anyone who is handy with tools can do the same with material to be found in any machine shop.

The construction of the pencil is as follows:—From a piece of 14 B. and S. steel piano wire make a coil spring of about 40 turns. Into this spring a soft iron core is inserted, after being insulated with rather stiff brown paper. One turn of the spring coil should be turned up and a terminal placed in it. (See sketch.)

The lower end of the spring should be U-shaped and the tip looped, as shown. A small iron screw and nut are used for fastening a small piece of copper wire, which serves as the etching needle. Cover the entire pencil with a few layers of stiff brown paper, dip in insulating varnish, and allow to dry.


Core - 20 pieces of No 22 B&S gage soft iron wire
40 turns No 14 B&S piano wire
110 volts A.C.
No 14 gage cord
150-watt toy transformer
Continuation of piano wire
Small iron bolt to fasten copper tip
No 20 gage copper tip
Steel plate for holding articles to be etched

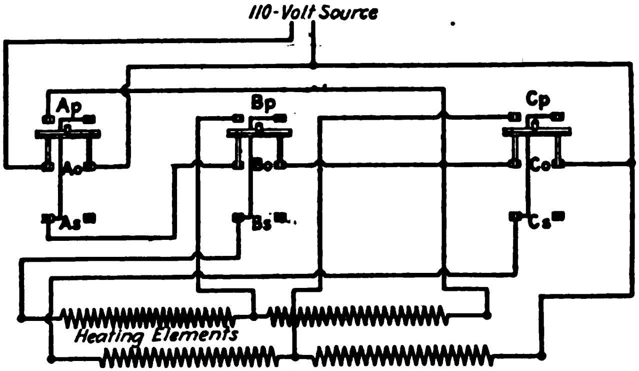
In operation the small iron screw and nut holding the piece of copper wire vibrate and the point makes a series of small dots. After a little practice it will be found to be possible to follow lines marked upon any metallic material with great accuracy. A small transformer will transform the voltage to from 4 to 10 volts. The pencil will be found to warm up a little if used for any great length of time. It should, therefore, be laid upon one side until it cools.—J. A. T.

No. 13.—How Resistance Values were Altered by Means of Switches.

In order to change the current of an electric oven over wide ranges, I connected up the resistances to three double-pole switches, as shown in the sketch. The combinations were:—

Position of switches.	Total amperes.
As Bs Cs	3·75
As Bp Cs	6
Ap Bs Co	7·5
As Bp Cp	15
Ap Bp Co	30
Ap Bp Cs	37·5
Ap Bp Cp	60

From this it will be seen that currents from 3.75 amperes to 60 amperes were obtained. The heating elements were quite small and closely spaced, so that



the suppression of the elements in some of the combinations did not alter the heat distribution to any great extent.—V. M. A.

No. 14.—How the Proper Combination of Motors and Flywheels Increases Power Factor.

In shipbuilding yards, punching and shearing machines are equipped with flywheels. Where these machines are motor-driven with induction motors, low-power factors, which are often caused through over-motoring, can be eliminated by a careful study to obtain the best combination between motor and flywheel.

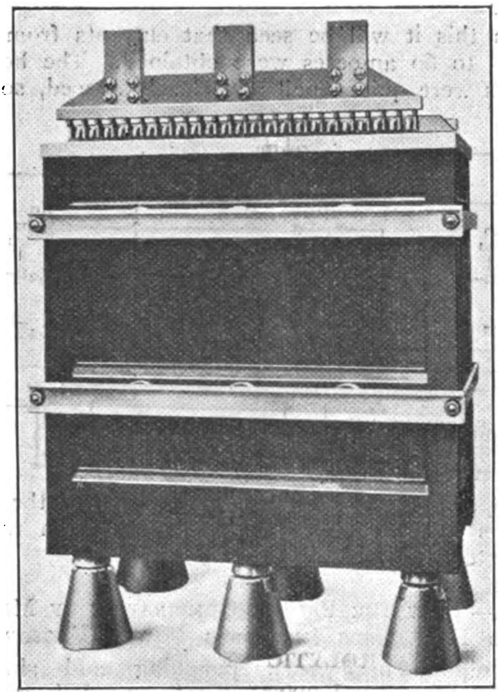
In many cases it will be found that the motor will do duty without the flywheel. In one shop in the works where I am employed a 200-h.p. squirrel-cage motor had a power factor which varied between .4 and .6. A heavy flywheel was used, but the motor had only about 2 per cent. slip, and, therefore, virtually carried the whole load. This condition lasted only a few seconds out of several minutes, so that most of the time the motor was running idle. By an analysis of the conditions and an altered combination of motor and flywheel, a 50-h.p. motor now does the work, and the wattless component of power is considerably reduced.—C. W. Drake.

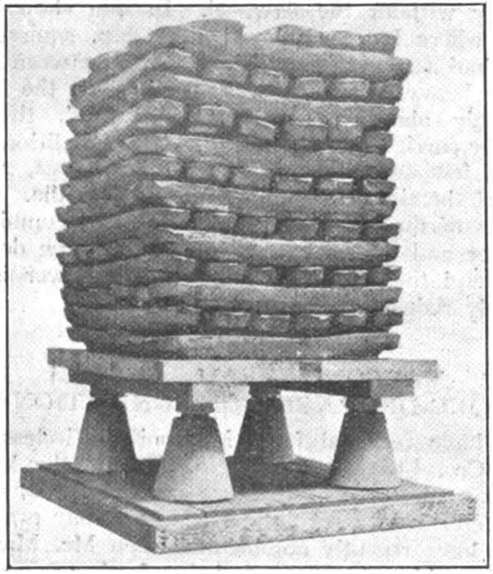
THE MARCONI BEAM SYSTEM FOR LONG-DISTANCE COMMUNICATIONS.

We have received from Marconi's Wireless Telegraph Co., Ltd., Pamphlet No. 231, on the Marconi beam system for long-distance communications, very aptly described "a revolution in present-day practice." As we have recently commented upon Mr. Marconi's lecture on this subject, we feel that further reference to the matter on our part is not necessary, particularly as the pamphlet is a précis of Mr. Marconi's lecture, and it does in fact refer the reader for further information to the *Journal of the Royal Society of Arts*, Volume LXII, in which Mr. Marconi's paper, read on July 25 of this year, is given in full.

AN INTERESTING TEST.

In connection with a contract for a large storage battery for the Hull Corporation, the Chloride Electrical Storage Co., Ltd., are introducing a new system of support for the cells which does away with the usual wooden stillage for large batteries. This arrangement consists of a number of tall pedestals made of glazed stoneware surmounted by porcelain insulators; 4, 6 or more such pedestals carrying each cell.





Before erecting the whole battery it was decided to make a severe test of these pedestals, to ensure that they would carry the weight for which they are designed, and also that they would not chip or splinter at the feet through surface inequalities of the metalline brick floor of the accumulator room. The accompanying illustration shows a test load of 8,600 lb. arranged on four of the insulators, the weight obtained by stacking pigs of lead on a wooden platform. The insulators under test show absolutely no distress or tendency to crack or splinter, and the photographs are given as of interest to show the construction of this type of accummulator support.

The battery for the Hull Corporation consists of 264 cells of the Chloride Company's JGW.25 type, and has a capacity of 6,600 ampere hours.

Trade Notes.

The **Sloan Electrical Co., Ltd.**, of 8, 10 and 12, Golden Lane, E.C.1, have issued a new booklet dealing with commercial lighting fixtures. It illustrates a large variety of shades, reflectors, signs and fittings which will be of direct interest to all contractors and trade dealers, to whom the list will be forwarded on receipt of proper application.

A new list from the **Sun Electrical Co., Ltd.**, of 118, Charing Cross Road, London, W.C.2, gives full particulars of the well-known Sunco electric fires, as well as a representative selection of the products of other leading manufacturers. It is claimed that all the fires illustrated have proved to be excellent lines, for the retailer to handle or for the contractor to install, and the catalogue (No. 413) should be of direct interest to trade readers generally at the present period of the year. It will be sent on receipt of proper application.

Circular T107, which has just been issued by the **Foster Engineering Co., Ltd.**, of Morden Works, London, S.W.19, gives illustrations and details of the latest types of the well-known Foster transformer, of which over 53,000 have already been constructed. The list is accompanied by a handy blotter advertising the Foster Ironclad Switch and Fuse Gear, which is also certain to be appreciated by all trade readers.

A catalogue of 48 pp. describing and illustrating the Simplex Industrial Lighting Fixtures has just been issued by **Simplex Conduits, Ltd.**, of Garrison Lane, Birmingham. It contains much information of interest to installation contractors and lighting engineers, including a helpful page on "How to Plan an Industrial Lighting Installation," together with a curve chart, which provides a ready method of selecting the correct size and type of Simplex reflector designed for the attainment of the best illumination of any particular area. The catalogue should certainly be in possession of all contractors and electricians generally, and will be sent to any reader on receipt of proper trade application. The list is No. 1040.

List No. 412, which has just been issued by the **Sun Electrical Co., Ltd.**, 118, Charing Cross Road, London, W.C., gives 32 pages of illustrations and text dealing with the latest types of domestic electrical appliances. It covers a very wide variety of articles, designed mainly for home use, but many of which have a far wider field. It includes items such as electric irons, kettles, teapots, toasters, boiling rings, violet ray outfits, sewing machine motors, suction cleaners, washers and other appliances too numerous to set forth at length. The catalogue is, therefore, one of direct interest to every electrical contractor and factor.

"Condensing Apparatus," No. 112, is the title of a well illustrated 90-page catalogue which has just been issued by **Messrs. Worthington Simpson, Ltd.**, of Queen's House, Kingsway. It contains illustrations and details of the latest types of condensing apparatus, air circulating pumps, jet condensers and other central station accessories which are used in all up-to-date plant, and as such it will appeal to central station engineers generally, to whom copies will willingly be sent on application. A chapter dealing with low-pressure steam tables by Messrs. Marks and Davis is of direct technical value, and should, therefore, be much appreciated, as should also a table of equivalents on page 81.

List B, which has just been issued by the **Billing Tool Co.**, at 303, High Holborn, London, W.C.1, gives illustrations of various lathes, vices tools, and sundries which they are offering at bargain prices. It should interest manufacturing electricians and engineers in charge, to whom it will be willingly sent on application.

A circular illustrating and describing their universal electric drills has been issued by **Messrs. Ibbetson and Co.**, engineers, of 57/8, Chancery Lane, London, W.C.2. It will interest all users of these very handy electric tools, and should be asked for.

Reviews of Books, &c.

[Books noticed in this column will be sent from Electricity *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

Automatic Telephones. By Ellson. (Pitman, 5s. net.)—Another welcome addition to the sparse literature on this subject, the book deals in simple language with the comparative principles of manual and automatic switching, and goes on to describe in moderate detail the four best known systems, viz., the A.T.M., Siemens, Western Electric, and Relay.

The method of treatment is commendable and avoids that tedious repetition associated with text accompaniments to complicated circuit diagrams. Interesting comparisons are drawn between the several systems described and the reference value of the book is enhanced by the inclusion of British Standard Terms and Definitions for use in connection with automatic telephone systems.

The Strowger Director System is all too briefly referred to, and the new lettered dial forms the subject of an accompanying illustration.

The illustrations are by no means good, although the diagrams are clear; the half-tone of the Western Electric System, Plate III., is practically illegible, due to the choice of an unsuitable screen.

Summarising, the book is quite good value for students and telephone men who are desirous of improving their knowledge of the Strowger and other automatic telephone systems now coming into common use in this and other countries.

Developments in Power Station Design. By Edwin Austin. Quarto, cloth, 271 pp., 239 illustrations. (Constable, 31s. 6d. net.)—This is another of "The Engineer" series, and the author is probably well known to quite a number of the central station engineers, who will read this book with keen interest and value it for the very sound practical information which it gives in regard to central station growth and progress during the past decade. Changes have been, and are being, made in many directions, and it is likely to continue in a steadily increasing ratio, although the growth of the super power station is likely to cause a slowing down after a time because of the closing down or absorption of the smaller stations in which the need for reorganisation or renewal of plant is now most evident. In regard to machinery and apparatus, Mr. Austin is distinctly cosmopolitan and describes impartially the manufactures of firms in Great Britain, America, France and Switzerland, giving the results obtained from pulverised fuel at Milwaukee, waste heat plant at a French steelworks, and Oerlikon turbines with special methods of admitting extra steam during times of overload. More than twenty pages are devoted to oil fuel and the various burners used in the combustion thereof, while the chapter on low temperature carbonisation is also most interesting. The leading types of boilers for present-day central station use are described and fully illustrated, the Spearing and Thompson having ample mention, while other chapters are devoted to mechanical stokers, pneumatic coal-handling plant, turbo-generators, instruments, switchgear, transformers, etc. There is a wealth of diagrams, curves, etc., which add materially to the educational value of the book as a guide to present-day central station design and practice, and we can most cordially recommend it to all our readers who are interested in this particular branch of electrical engineering. The printing and production are alike excellent.

For Electrical
Engineers & Electricians

D.C. DYNAMO AND MOTOR FAULTS.
By R. M. Archer, B.Sc. (Hons.), A.R.C.S., M.I.E.E. An elementary work dealing with the causes, symptoms, diagnosis and treatment of the faults and troubles commonly experienced in the operation of d.c. Dynamos and Motors. For students, central station engineers, and those in charge of electrical installations. 7/6 net.

POWER STATION EFFICIENCY CONTROL.
By John Bruce, A.M.I.E.E. This book is intended chiefly for power station engineers, consulting engineers, and students of electrical engineering. It contains a résumé of modern methods of controlling the efficiency of electrical generating plant on the steam and electrical sides. By its use the power station engineer will be assisted in obtaining the most economical performance from the plant under his control. 12/6 net.

POWER WIRING DIAGRAMS.
By A. T. Dover, M.I.E.E., A.Amer.I.E.E., Head of the Electrical Engineering Department at the Battersea Polytechnic, London. A handbook of Connection Diagrams of Control and Protective Systems for Industrial C.C. and A.C. Machines and Apparatus. New edition. In pocket size, with 254 illustrations. 6/- net.

THE ELECTROLYTIC RECTIFIER.
By N. A. De Bruyne. A useful survey of present-day theory and practice for electrical engineers, physicists, and wireless amateurs. Explains how to make and use a rectifier for charging accumulators from alternating current supply mains. With 23 illustrations. 3/6 net.

THE ALTERNATING CURRENT CIRCUIT.
By Philip Kemp, M.Sc. Tech., M.I.E.E., A. Amer.I.E.E., Head of the Electrical Engineering Department at the Polytechnic, Regent Street, London. The present little volume is intended to serve as an introduction to the subject, and aims at giving a clear but simple explanation of the various phenomena exhibited by the alternating current circuit. A liberal use of vector diagrams has been made. 2/6 net.

RADIO COMMUNICATION.
By J. H. Reyner, B.Sc. (Hons.), A.C.G.I., D.I.C., of the Post Office Engineering Department. A manual of modern theory and practice, covering the syllabus of the City and Guilds Examination and suitable for candidates for the P.M.G. Certificate. 121 illustrations. 5/- net.

AUTOMATIC TELEPHONES.
By F. A. Ellson, B.Sc. Hons. (Vict.), A.M.I.E.E., Engineer G.P.O. An introductory treatise dealing with the fundamental principles, methods and advantages of automatic telephony. With descriptions of apparatus circuits and operation. For students, telephone operators and others. 5/- net.

THE ELEMENTS OF ELECTRO-TECHNICS.
By A. P. Young, O.B.E., M.I.E.E. This book explains in simple language the fundamental principles of the electrical industry and abounds with practical illustrations. The scheme is similar to that laid down by the City and Guilds of London Institute. 178 illustrations. 5/- net.

OF ALL BOOKSELLERS.

Full Particulars post free from—
PITMAN'S, PARKER STREET, KINGSWAY, W.C.2.

THE CHOICE OF SWITCHGEAR FOR MAIN AND SUB-STATIONS. By W. A. Coates, M.I.E.E. Royal 8vo, 296 pp., with 234 figures. (Blackie, 20s. net.)—This book will appeal to every consultant who has to prepare central station plant specifications, as well as to the actual central station engineer or assistant who has to supervise or attend to the operation thereof, and as such we can most cordially recommend it. The author is an expert on his subject, and he has, in addition, had kindly assistance and advice from other engineers whose names carry weight in this particular branch of our industry, so that the work will prove of the utmost value to the user who seeks its assistance. The physical principles governing high-tension and low-tension switching are discussed in an able manner, and the details given should enable those preparing purchasing specifications to plan out the most appropriate designs and make intelligent comparisons when considering alternative tenders which may be based thereon. The treatment is essentially broad, and no particular system or school of practice is held up as "the best," and readers are left free to use their own discretion. The book will be appreciated accordingly, and should find readers all over the world.

Various Items.

Castlereagh.—The Belfast Corporation has applied for the consent of the Rural District Council to the granting of an order by the Electricity Commissioners authorising the Belfast Corporation to supply electricity to Stormount. A plan of the undertaking is to be submitted.

An Important Order.—The Vickers and International Combustion Engineering, Ltd., have just closed a contract for the power plant of a large flax mill in Belfast, owned by the York Street Flax Spinning Co., Ltd. It is to generate electric energy at a very low figure for driving and lighting the largest flax mill in the world. The boilers will be of the B. and W. type with "Lopulco" pulverising plant.

Second-hand Turbo-Alternators for Sale.—The Victorian Govt. Rys. Dept. invite tenders for the purchase of two second-hand 500 K.W. turbo-alternators, 2,100 volts, single phase, 50 cycles. 3,000 r.p.m., manufactured in 1912, which they have available for sale. Both sets are in good running order and condition, having been in commission until recently in the Spencer Street Power Station of the Victorian Rys. Commissioners. Fuller particulars may be obtained from the Agent-General for Victoria, Melbourne Place, Strand, W.C.2.

The Institute of Metals.—The programme for the Session 1924-25, which commences on October 1, has just been issued. It covers not only the work of the parent Institute, but of its six branches located in the various metallurgical centres. Over thirty important lectures dealing with various phases of non-ferrous metallurgy are enumerated, including the annual May lecture by the distinguished Dutch scientist, Professor H. A. Lorentz Copies of the programme can be obtained from Mr. G. Shaw Scott, M.Sc., 36-38, Victoria St., Westminster.

Institute of Transport.—The first meeing of the Session 1924-25 will be held in the Lecture Theatre of the I.E.E., Victoria Embankment, W.C.2, on Monday, October 6, when Sir Joseph G. Broodbank will open the proceedings and present the awards for 1923-24. Following his induction as President, Sir Lyndon Macassey, K.B.E., K.C., will deliver his Inaugural Address, which will, in the main, deal with the London Traffic Problem. Applications for a visitor's card should be made to the Secretary, at the offices of the Institute, 15, Savoy Street, London, W.C.2.

Quotations Wanted.—The Electricity Dept. of the City of Cape Town is inviting tenders for the supply and delivery of 500 or alternatively 1,000 street light fittings, each consisting of reflector, lampholder pipe, finial, porcelain insulators, lock-nuts, etc., etc.——The Turkish Posts and Telegraphs Administration, Constantinople, invite tenders for the supply of 30 galvanometers.——The Public Works Tenders Board, Wellington, N.Z., are calling for tenders for switchgear for the Ngongotaha Sub-station of the Waikato Power Scheme. Specifications, etc., from the D.O.T. (Room 52), 35, Old Queen Street, London, S.W.1.

Change of Address.—The address of the Weston Electrical Instrument Co., Ltd., is now 15, Great Saffron Hill, London, E.C.1. They retain their present Telephone No. and Telegraphic Address, namely: Holborn 2029; Pivoted, Smith, London; the Cable Address being, as before, Pivoted, London.

N.-W. Midlands Electricity District.—The Electricity Commissioners will hold an interim local inquiry in the Town Hall, Wolverhampton, on Tuesday, October 21, at 10.30 a.m., and following days, with reference to the proposed amendments to the scheme originally submitted by the Conference, and to the area now proposed by the Conference to be constituted an Electricity District, and with reference to other matters incidental thereto.

Meetings.—The Junior Inst. of Engineers will meet on Friday, 3rd inst., at 39, Victoria Street, S.W.1, at 7.30 p.m. Lecture, "Explosions, Terrestrial and Celestial," by Prof. A. W. Bickerton, A.R.S.M. Also on Friday, 10th inst., at same time and place, paper, "The Design of Static Sub-stations, with Some Notes on Their Equipment," by N. Thornton, A.M.I.E.E. (member); slides. And on Friday, 17th inst., at the Royal Society of Arts, John Street, at 7.30 p.m., special meeting. Lecture, "High Voltage Electric oscillations," by R. P. Howgrave-Graham, M.I.E.E. (of the Northampton Polytechnic Institute).——The Institution of Engineers-in-Charge will meet at St. Bride Institute, Bride Lane, Fleet Street, E.C.4, on Wednesday, October 8, at 7.30 p.m. prompt, when a paper will be read by R. J. Penn, Esq., on "The Testing of Aero-Engines in Flight."——E.D.A. Salesmanship Conference No. 2 (London area) will be held at Caxton Hall, Westminster, Friday, October 24, 7.30 p.m. Paper by Mr. H. Marryat on "Contracting for Pleasure and Profit." Chairman, Mr. W. A. Ritchie (Hendon Electric Supply Co.).——The Western Centre of the I.E.E. will meet at the Merchant Venturers Technical College, Unity Street, Bristol, at 6 p.m. on Monday, 6th inst., when Mr. W. Nairn, the chairman, will deliver his inaugural address.

Royal Technical College, Glasgow.—Congratulations to the Beama on the way in which various members of this important industrial Association have supported an appeal of the Royal Technical College, for the presentation of new equipment representative of the latest improvements in electrical engineering. Prof. S. Parker Smith desires publicly to thank the Association for its immediate and sympathetic response to the appeal and its members for their very generous gifts of modern machinery and apparatus in wide variety, among the donors being the British Electric Transformer Co., Ltd., the B.T.-H. Co., Ltd., Electric Control, Ltd., the English Electric Co., Ltd., Electromotors, Ltd., Ferranti, Ltd., the G.E. Co., Ltd., the Macfarlane Eng. Co., Ltd., Mavor and Coulson, Ltd., Metropolitan-Vickers Elec. Co., Ltd., Bruce, Peebles and Co., Ltd., and Allen, West and Co., Ltd. Mention should also be made of valuable gifts of electrical mining apparatus from Messrs. Reyrolle, Ltd., Ferguson and Pailin, Ltd., and Mr. George Ellison, which were made at the beginning of last session, in order that the mining students attending the College might obtain experience with the types of switchgear they would be called upon to use later. The new machinery and apparatus will enable the College to modernise the laboratories and to relieve congestion by having fewer men in each group and by spreading a larger number of machines over increased floor area.

Sample Pair Sent on Approval for 8/6.
Made of Pure Para Rubber, soft and durable and unaffected by climatic conditions
DAVID MOSELEY & SONS.
Limited.
ARDWICK MANCHESTER.
MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
A PRACTICAL TRADE JOURNAL

OCTOBER 10, 1924.

CONTENTS.

	PAGE
The Wireless Exhibition	541
The Motor Exhibition	541
Electric Passenger Lifts	542
Electrical Engineering—Grade I.	544
Tests of the New Marconi Lifeboat Set	544
Current Topics	547
The Significance of Exhaust Temperature	549
The "M.O." Valve works	549
Questions and Answers by Practical Men	553
A Hundred Years of Electrical Engineering	554
Reviews of Books	555
Various Items	556
Trade Notes	556

THE WIRELESS EXHIBITION.

This important Exhibition, which was opened on Saturday, September 27, at the Royal Albert Hall, under the auspices of the National Association of Radio Manufacturers, and consisted only of All-British products, revealed in a remarkable way the growth and development not only of a new industry, but also the enterprise and capabilities of British producers and manufacturers, who in a short space of time have been able both to lead the way in design and determine the standards of efficiency of the details of apparatus which now commands world-wide interest and has become almost a necessity in any communal life.

Lord Riddell, in opening the Exhibition, declared the show as one "worthy of the trade and one which proves that the British industry stands highest of all," and in a speech later said that every person interested in wireless matters should visit the show and recognise what had been achieved by his countrymen. It was an achievement "which helped generally to make life more full and interesting."

Associated as it is necessarily with the electrical trade, it could not be otherwise than that the many well-known manufacturing producers in that industry would be fully represented, and amongst the larger and most important exhibits such firms as the General Electric Co., Ltd., the British Thomson-Houston Co., Ltd., the Western Electric Co., Ltd., the Sterling Telephone and Electric Co., Ltd., Falk Stadelmann and Co., Ltd., Edison Swan Electric Co., Ltd., and Alfred Graham and Co., Ltd., were conspicuous, and their products showed the high-class finish and appearance which is alone associated with lengthy experience and practice, coupled with the highly-trained mechanical and technical skill of a perfectly selected and organised staff. Besides these were many well-known firms who are solely and especially associated with wireless apparatus and details in connection therewith, as the various radio valve makers, including the Mullard Valve Co., Ltd., the Marconi Osram Valve Co., Ltd., and A. C. Cossor, Ltd., and also other firms who make a speciality of complete receiving sets and parts for home construction of such sets, amongst whom were Messrs. Burndept, Ltd., L. McMichael, Ltd., Peto Scott Co., Ltd., Wates Bros., Ltd., Radiax, Ltd., and others. Every kind of apparatus suitable for ordinary reception was to be seen on these stands, from the simple crystal set priced at 7s. 6d. to elaborate cabinets with multi-valve fittings and loud-speakers combined, having almost world-wide range and costing hundreds of guineas. Perhaps one of the most noticeable features in connection with this exhibition was the marked growth and development in the production of such minor but important details as tuning coils, transformers, coil-holders, terminals, valve-holders, and the many safety devices and gadgets in the application and use of which so much interest and zest is inspired, especially in the mind of the home constructor, and which give such stimulus to the trade. There are very few schoolboys or students with mechanical or technical inclinations who are not interested in wireless experiments, and their efforts often result in the imparting of a sympathetic concern on the part of their parents and elders, leading to many a visit to the dealer or maker and the obtaining of improved and more efficient complete equipment. The display of loud-speakers was especially interesting, and at a demonstration given at a neighbouring address near the Exhibition by one of the principal makers, a range of loud-speakers of varying capacities were displayed and operated during broadcasting hours, the results manifesting in a marked degree the advances made and the improved quality in volume and tone obtained by careful attention to the principles involved in designing and the mathematical precision and perfection of the delicate details used in construction, as well as the skill and accuracy involved in assembly. It was refreshing to be informed that not only were these goods finding a ready market in the home trade, but were being extensively exported and even taking the place of corresponding goods in such competitive and low-cost countries as Germany and America. Altogether, this Exhibition as a whole should give a very effective stimulus to British trade and an encouragement to the Association of Radio Manufacturers who inaugurated it.

THE MOTOR EXHIBITION.

The annual motor exhibition opens at Olympia on October 17, and will remain open until October 25. As usual, it will represent the last word in the progress of this great industry, giving the fullest possible visible demonstration of the improvements in design and reductions in price which have been made during the last twelve months.

Variety being charming, there is infinite variety in the models which will be on view: Engines with eight, six, four and two cylinders; side by side valves still put up a good fight against overhead system; three-speed or four-speed boxes have their adherents; coil and battery ignition contest the magneto for supremacy; the sleeve valve rightly finds strong support; and, although the six-cylinder cars are increasing in number and marketing at extremely tempting prices, there appears to be a lull in the battle of the cylinders, even the "six" diehards apparently arriving at the conclusion that there are many good points in a four-cylinder which cannot be denied, and for which there is a strong appeal among a large majority of motorists. That this point is recognised is demonstrated by observant manufacturers offering a choice of four- and six-cylinder models.

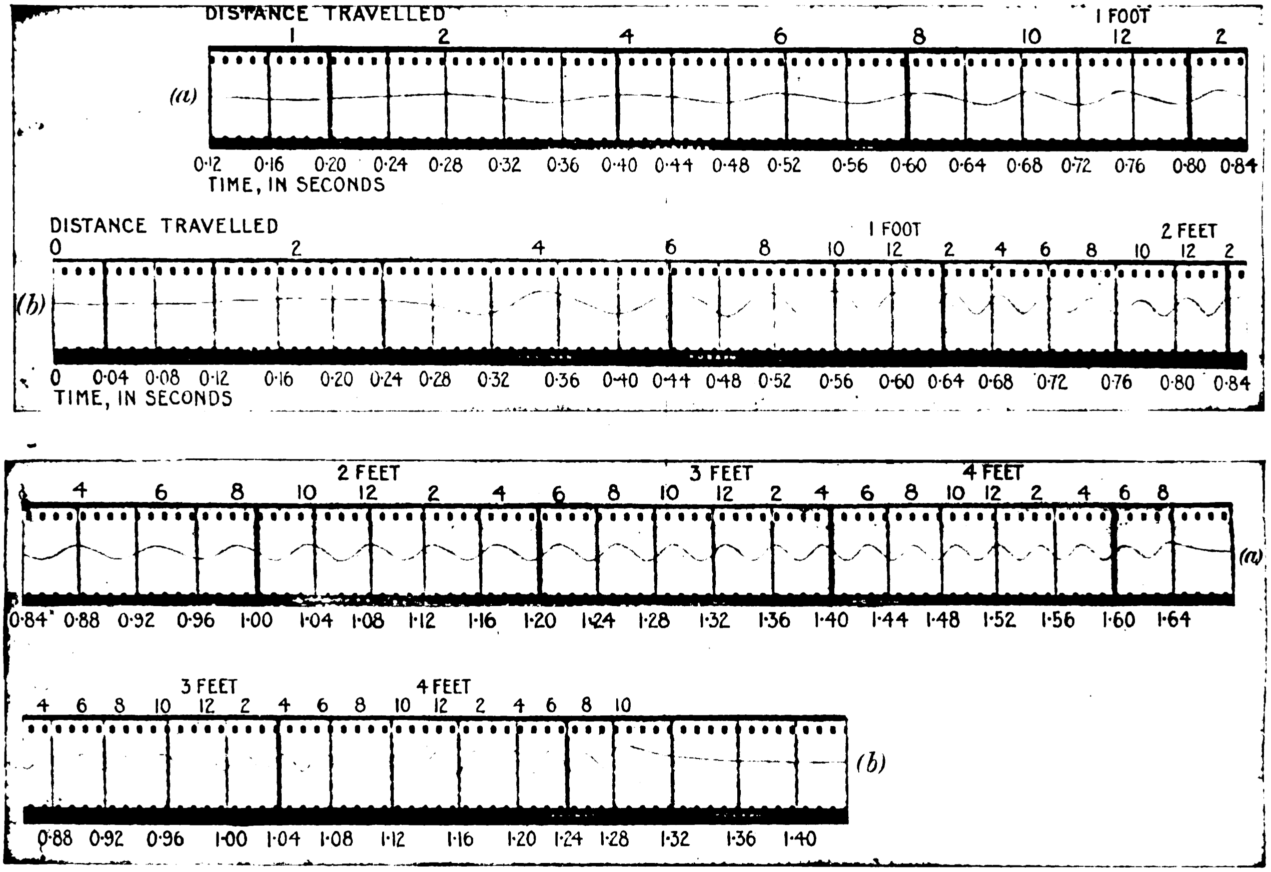
We expect, therefore, that quite a number of our readers will make a point of visiting Olympia during the period that the Exhibition will be open, and, what is more, we are certain that they will find many items of direct interest to them as electrical engineers, quite apart from the actual motor industry.

ELECTRIC PASSENGER LIFTS.*

By H. Marryat (Member).

(*Continued from page* 536.)

In order to investigate the effect of various forms of lift acceleration upon the average passenger, I have made a large number of experiments. The earlier efforts were very crude, the apparatus consisting of weights suspended upon strings, on the spring-balance principle, and arranged to record their motion upon a paper chart, the passengers at the same time being asked to note their physical sensations. With this apparatus it was discovered that the critical period of acceleration was too brief to be dealt with scientifically in this way. The next step was to devise an electrical method of recording what happened, and with the help of the Cambridge and Paul Scientific Instrument Co., and particularly of Mr. R. S. Whipple and Mr. Barron of that company, the following arrangement was adopted :—



(The actual position of the lower block should print horizontally here.)

Fig. 4 (*a*, *b*).—Reproduction of Two Films Obtained in Connection with Acceleration Tests on a Passenger Lift Having a Running Speed of 360 ft. per Minute.

A series of coils of copper wire are wound on the outside of a tube 6 ft. long and about 3 in. in diameter. These coils, which are spaced 2 in. apart and connected in series, are in circuit with a small string galvanometer, a feature of which is its short period of vibration. An image of the string of this galvanometer is projected by means of a "Pointolite" lamp on to a moving photographic film. The tube is inserted at the bottom of the lift shaft in such a position that the car can pass freely without fouling. Carried from an arm at the top of the car is a cord to the end of which is attached a small cobalt-steel magnet, its position being such that as the lift travels up or down, the magnet is made to move inside the tube, thereby inducing an electromotive force in the coil windings and causing a deflection of the galvanometer string, the movements of which are recorded on the photograhic film.

Accurate timing of the record is effected by a synchronous motor run from a tuning fork making 50 vibrations per second. This motor carries a disc, on the circumference of which are fitted five spokes, each being introduced in turn into the path of the beam of light. In this way the record is ruled with a series of lines, the space between any two of which represents

---

* Paper read before the Institution of Electrical Engineers.

0.04 sec. The film speed employed is approximately 3 ft. per sec., rendering it possible to read the record to 0.002 sec. In the record illustrated, the passage of the magnet through each coil is indicated by a deflection of the string, and reference to the time scale makes it possible to determine the time taken for the lift to rise each successive 2 in. By plotting "time" against "inches rise of lift" information is obtained from which a true acceleration or deceleration curve may be produced. In Figs. 4 (*a*) and 4 (*b*) are reproduced specimens of the films produced in this way. These films illustrate different forms of acceleration on a passenger lift running at 360 ft. per min. It should be noted that the time intervals indicated by the vertical lines upon the films are accurately controlled by the tuning fork method as described, but the space intervals vary as the result of variations in the film speed. A corresponding correction must be made in taking measurements from the films. This method has not, so far as I am aware, been used before for the purpose of obtaining such data.

From a study of these films we discover that the unpleasant sensations experienced by most passengers at the starting and stopping of a fast-running lift are due not so much to a too rapid acceleration as to a sharp change of acceleration, the result of imperfect control. The remedy is not an extension of the total period of acceleration, but a correction and smoothing out of the curve. Working upon these lines it is found possible to accelerate a lift to 300 ft. per min. within a space of 24 in., or to 600 ft. per min. in less than 48 in., without discomfort to the passengers, and to decelerate in a similar period. This means that the time lost in acceleration and deceleration of a lift at 300 ft. per min., with average runs of 42 ft., need not exceed 5 per cent. of the running time, and at 600 ft. per min., 10 per cent., the number of seconds lost being the same in each case. It also means a saving in energy consumption.

Fig. 5 represents a series of time/distance curves taken upon the starting of a 15-cwt. passenger lift running at 360 ft. per min. in a building in Kingsway. The different results are obtained by varying the armature starting resistance and the rapidity of cutting out.

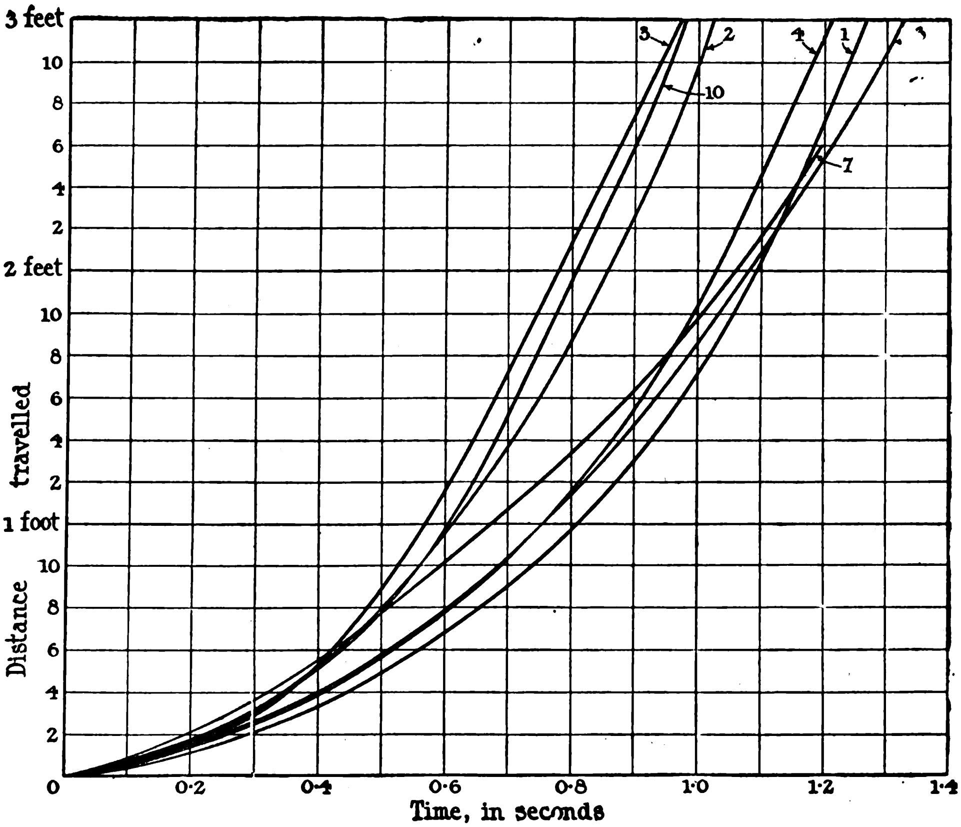


FIG. 5.

(*To be continued.*)

Motor Ships.—The current issue of the *Motor Ship* contains several articles of interest to electricians, including an account of a new type of electric winch fixed on the motor ship *Centaur*, as well as a diagram of the connections. It has been brought out by Messrs. John H. Wilson and Co., and shows marked divergence from normal design. There is an illustrated description of the "Ref" oil engine lubricator and also a good account, with diagram, of connections of the Scott-Donkin electric steering-gear on the *City of San Francisco*. Finally, there is a first-class article on a new auxiliary Diesel engine for generator driving. Quite an electrical issue.

Smoke Abatement.—A Smoke Abatement Exhibition is to be held in Manchester in November, and in connection therewith a conference will be held, of which an advance programme has been issued by the Smoke Abatement League of Great Britain, 33, Blackfriars Road, Manchester. During the conference several very interesting papers will be read by leading specialists on the subject of smoke abatement, including "The Effect of Light on Health," "The Use of Electricity in Smoke Abatement," etc., and we think that this latter section should prove of direct value as a means of emphasising the value of electricity in purifying the atmosphere of all great towns and manufacturing centres. The programme is accompanied by a preliminary list of the exhibitors at the Exhibition, in which we notice that quite a number of important electrical firms will be represented.

ELECTRICAL ENGINEERING—GRADE I.*

Solutions to 1924 *Examination Questions of the City and Guilds Institute.*

BY EDWARD HUGHES, B.Sc. (Eng.), A.M.I.E.E.

(*Continued from page* 528.)

Q. 4.—An electric kettle, having an efficiency of 0.85, is required to raise the temperature of two pints of water from 15 to 90° C. in ten minutes. If the supply voltage is 200, calculate what resistance the heating element must have. One calorie = 4.2 joules.

A. 4.—There are 8 pints in a gallon.

$\therefore$ weight of 1 pint of water $= \frac{10}{8} = 1.25$ lbs.
$= 1.25 \times 454$ grams,
$= 567$ grams.

$\therefore$ heat required to raise 2 pints of water from 15 to 90° C. $= 2 \times 567 \times 75$ calories,
$= 2 \times 567 \times 75 \times 4.2$ joules,
$= 357{,}000$ joules.

Let R = resistance of heating element,

$\therefore$ power generated in resistance $= \frac{V^2}{R} = \frac{(200)^2}{R}$

$\therefore$ energy input to heater $= \frac{(200)^2}{R} \times 10 \times 60$ watt-sec. or joules, and energy given to water $= \frac{(200)^2}{R} \times 10 \times 60 \times 0.85$ joules.

Hence $\frac{(200)^2}{R} \times 10 \times 60 \times 0.85 = 357{,}000.$

$\therefore R = 57.2$ ohms.

Q. 5.—Give a diagram of a horseshoe-shaped electromagnet showing the direction of current in the windings and the polarity induced. Upon what factors does the strength of an electromagnet depend?

A. 5.—Fig. 3 shows a winding supplied from a battery, the arrowheads on the windings indicating the direction of the current. The dotted line shows the path of the magnetic field, and the arrowheads on it indicate the direction of that field.

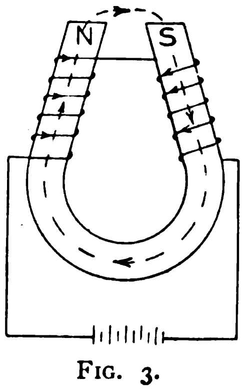


FIG. 3.

The strength of the magnetic field depends upon:—
(*a*) Number of turns on coil,
(*b*) Current through coil,
(*c*) The reluctance of the magnetic circuit, and this in turn depends upon—
(1) Length of airgap between poles,
(2) Area of pole face,
(3) Material and dimensions of iron core.

If the magnetic leakage be neglected, the total flux is given by:—

$$\phi = \frac{1.257\ IT}{\text{Reluctance of magnetic circuit}}$$

where I = current through coil,
T = no. of turns on coil,

and the reluctance $= \frac{l_c}{\mu a_c} + \frac{l_a}{a_a}$

where l_c and a_c = length and section resp. of iron core,
l_a and a_a = „ „ „ „ „ airgap,
and μ = permeability of iron core.

(*To be continued.*)

TESTS OF THE NEW MARCONI LIFEBOAT SET.

During the recent voyage of the *Maloja*, the first vessel to carry the new Marconi wireless set for ships' lifeboats, this installation was subjected to a series of tests to ascertain its behaviour under actual service conditions. Preliminary trials in the Mediterranean, with the boat hoisted, gave satisfactory results, and an exacting test under service conditions was imposed at Melbourne, where the lifeboat was lowered, and the set tested while the boat was cruising in Port Philip, there being a fresh breeze and a short and choppy sea.

Clear, strong signals were received by the boat from the *Maloja*, and from neighbouring wireless stations, and the operator, by means of the directional receiver of the set, was able to obtain bearings of any of them, within one point of the compass of accuracy. In view of the adverse conditions, this result may be regarded as very satisfactory.

Signals transmitted from this type of lifeboat installation can be clearly received by the ordinary ship's installation at distances over fifty miles.

Quotations Wanted.—The Municipal Council of Johannesburg are calling for tenders for the supply of one 750 kw. Rotary Converter.——The Cape Town Electricity Dept. are calling for tenders for the supply of low-tension A.C. switchgear.——The Electricity Dept. of the St. Gilles Municipality (Belgium) are calling for tenders for the supply of armoured cables.——The Electricity Supply Department of the Municipality of Bloemfontein are calling for tenders for the supply and installation of the material required for the interior and exterior power and lighting circuits in the Council's new power station.—Also, they invite tenders for the supply, delivery, erection, testing on site and setting to work of a complete installation of high-tension and low-tension switchgear, works and lighting transformers, auxiliary motor switches, battery cablework, etc., which is required to control the electrical side of a generating station consisting of one 1,000 (one thousand) kw. and two 3,000 (three thousand) kw., 2,200-volt, 50 cycle, three-phase turbo-generators and electrically driven auxiliaries, with the possible extension in the future of one 3,000 (three thousand) kw. set; and for the supply, delivery, erection and testing in the Council's electric power-station of two steam turbo-generators with condensers, circulating water and other pumps, electric motors and all inter-connecting piping. Specifications, etc., from the D.O.T. (Room 52), 35, Old Queen Street, London, S.W.1.

---

* Books recommended are *Elements of Electrotechnics*, by Young (7s. 10d. post free), and *Technical Electricity*, by Davidge and Hutchinson (13s post free), both from S. Rentell and Co., Ltd., 36, Maiden Lane, London, W.C.2.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of
CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N. 17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription : 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited, and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL & CO., LTD., 36–39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

Those Breakdowns.

With the end of summer time and the consequent earlier peak load on power station generating plant has come a recrudescence of the electricity supply failures which were such a disquieting feature last autumn. During the past week temporary cessation of supply has been reported from Belfast, Manchester, Aberdeen and Whitehaven. The Aberdeen breakdown is reported in the local press as being the third in less than three months, and the tramway service was affected in addition to the supply to ordinary consumers. At the time of writing no explanation as to the cause of the stoppage is available. The Manchester failure was due to a fault on one of the 33,000 volt feeders through which the new Barton station serves certain districts in the city, the particular areas affected being Withington, Fallowfield, Didsbury, and a small portion of Rusholme. The Belfast failure also affected the tram service and was due to switchgear breakdown, whilst the Whitehaven trouble is stated to have been due to a new turbo-generator at the power station.

With the evenings growing longer these temporary breakdowns are more noticeable, due to the absence of electric light at periods when it is most required, and they consequently react as very adverse advertisements of the reliability of electricity supply. In the circumstances we cannot do better than repeat our warnings of last year and counsel all responsible power station engineers and mains superintendents to overhaul their systems most thoroughly and eliminate the weak spots at the earliest opportunity. It is not always possible to avoid a breakdown, but rigid and systematic inspection should go far towards lessening the risks. Prevention is better than cure, anyway, and we want to do as little as possible to discount the good efforts of E.D.A. and other organisations in winning over new consumers.

The New Telephone Call Boxes.

According to report the new automatic telephone call boxes which have recently been installed in the London area constitute veritable "boxes of tricks" to certain members of the public who will not take the trouble to read and profit by the very clear instructions for use which are attached to each box. As a result certain shrewd urchins are reaping a harvest by virtue of their powers of observation coupled with an intelligent study of those self-same instructions. A newspaper reporter watched the operations of these same small boys at Charing Cross Underground station, where these boxes are installed in the silence cabinets. He states that the victims are nearly always women who apparently will not read the instructions before making a call. After dropping the coins into the slot provided, the caller asks for a number and is connected by the operator.

There is, however, no response to the speaker's next remark because she has failed to press button "A," as clearly indicated. The small boy's opportunity comes when the disgusted caller finally vacates the silence cabinet, assuming that the telephone is out of order. He promptly enters and immediately proceeds to carry out the second instruction, which runs as follows : "If no call eventuates, press button marked 'B' and the money will be returned," and so it is, but not in this case to the disgruntled caller. The small boy reaps the reward of his ingenuity and intelligence. Frankly, I am of the opinion that people who cannot make intelligent use of these new call boxes deserve to lose their money. The official instructions are very clearly set out in the simplest possible language, and if properly carried out ensure satisfaction. The incident prompts the reflection that the Post Office will need to issue very clear and concise instructions as to "dialling" in connection with the forthcoming Strowger Automatic Telephone Exchanges in London.

The Call of Wembley.

The British Empire Exhibition has now entered upon its final month, and it behoves all who have not yet visited and inspected its many marvels to do so without delay. Londoners are generally credited with having neglected this foremost attraction at their very doorsteps, and inasmuch as the exhibition has done so much to benefit Londoners of all classes this season, the least the dweller in the Metropolis can do is to patronise it to the extent of at least one visit whilst the opportunity serves. Although chilly, the weather has been more generally favourable, and in any event there is plenty of cover at Wembley in the event of a downpour. I sincerely trust that all my London readers who have not yet done so will visit Wembley before it is too late; there is every inducement to the visitor interested in anything electrical, housed in the Palace of Engineering alone.

The New Zepp.

The completion of the latest Zeppelin, ZR 3, and its projected voyage to U.S.A. under the Reparations Agreement, is of general interest to our readers in view of the electrical installation. In the kitchen, for instance, is a modern electric range upon which full meals for thirty persons can be prepared, and hot-water supply is available from an electric heater, the storage tanks being located in the hull of the airship overhead. Electricity for the range, lighting, and for heaters in the passenger compartment is generated by two special dynamos attached to the exterior of the car. Small propellers are affixed to the generator shafts and are driven by the force of the air against them as the ship speeds on. When the generators are not required they are tilted so as to bring their propellers out of the wind stream.

Broadcasting.

With the advent of the annual All-British Wireless Exhibition at the Albert Hall, it is interesting to review the progress which has been made in this popular recreation and hobby since its inception, and we are indebted to the National Association of Radio Manufacturers for the following figures. In September, 1922, wireless reception was the hobby of a few thousand amateur experimentalists; but with the inauguration of the programmes of the British Broadcasting Company an immense increase in popularity resulted. In September, 1923, a total of nearly 170,000 licences for receiving sets had been issued by the G.P.O., and by the beginning of the present month this number had swelled to over 900,000. At a modest computation this means that wireless entertainments are listened to by at least three million people every evening, a considerable proportion of whom are past, present or potential purchasers of wireless receiving sets and associated components.

Lighting Overhauls.

This is the time of year when electrical contractors can profitably devote some little attention to the general overhaul of lighting installations in their respective districts. Blackened and burnt-out lamps which have survived the light nights of " summer time " call for renewal, as do also broken and obsolete reflectors and fittings. The semi-indirect type of bowl fitting is a most efficient collector of dust and insects, whose presence is unsuspected until the bowls are removed for cleaning. The very convenience and reliability of electric lighting militate against a regular overhaul, and comparatively few installations receive the periodical inspection and cleaning which are desirable in the interests of efficiency. Only when the general lighting begins to depreciate to a noticeable extent does the average consumer begin to investigate the cause, whereas had he contracted for a regular overhaul with his local contractor he would never have experienced the deterioration. It is distinctly false economy to pay for current expended in producing illumination, 50 per cent. or more of which is unable to penetrate the coating of foreign matter which surrounds the glass bulb and prevents reflecting surfaces from functioning.

About a " Live" Grid.

They have been having some fun in Manchester. One of the local papers described it in the following thrilling headlines:—" Shocks for All. Why Crowd Danced in City Street." Yes, as you will have guessed, our friend the " juice " has been up to its antics again. As a rule, it only favours ourselves in the matter of shocks, and so in time we become accustomed to its attentions and survive " bites " which would probably lay low most outsiders. In this case, however, the general public came in for some of its pettishness. It was difficult to get any real facts out of what the reporters had to tell us. One said that a grid in the street became short-circuited and that soon there were over a dozen people dancing about, while another (whose editor had cut him down to about fifty words) affirmed that only one or two passers-by were affected. Anyway, all the reporters seemed quite gleeful about the incident—so much so that it was quite clear that *they* took jolly good care to keep away from the "short-circuited " grid. It was left to a sergeant and a constable to settle the matter. You will remember that long ago the police used to do nothing else but be missing when your house was burgled, and it was said that they had an extraordinary faculty for eating big pies and kissing fat cooks. Then they went in for an enlivening game called traffic-directing. And now—now they've taken up electric work!

Well, the electrical bobbies barricaded off the live grid—I suppose by standing so that their feet surrounded it. Apparently the proprietor of the shop did not like such steps, and he remonstrated. Of course, this had no effect. If he had asked the way to, say, the Town Hall, or inquired when the next Police Sports would be held, he might have got a hearing. Really, that proprietor was most backward. If he had put up a notice about the marvellous tonic properties of electricity and charged threepence a time for shocks from the live grid, he would have done a roaring trade—the amount of roaring at any moment depending on the leakage. People never seem to mind being hurt when they pay for it. Of course, the limbs of the law might have objected to the proprietor thus turning himself into a public benefactor; but then, I don't see why they should. After all, I imagine that the live grid would give such hefty shocks that patients would have no hesitation about *moving on.*

Shocks—and Shocks.

The incident of the live grid reminds me of an engineer I once met who recounted an incident in the early days of electric trams. One wet day he was descending from the rearward step, and, on reaching the ground, he received a severe shock from the brass rail which he was still holding. The next passenger to dismount also received a shock *and dropped dead.* I have heard of a still earlier episode in electrical history, when, in one of the first power stations, shocks were inevitable whenever a crude open-type switch was operated by hand. The engineer, after some thought, solved the problem by attaching a length of rope to the switch, flinging it over a beam, and so arranging it that the switch could be opened and closed by means of the rope. I like best the story of the man who runs a village electric lighting scheme. He knew a little about the engine, but next-to-nothing anent the electrical side. When asked how he became aware that a fault existed, this was his naive reply:—" Well, if I close the switch and there's a mighty big flash and I get knocked on my back, why, I know there's a fault on! " It seems simple enough.

ELEKTRON.

We believe in strict discipline for everybody else.

THE SIGNIFICANCE OF EXHAUST TEMPERATURE.

At the meeting of the Diesel Engine Users' Association on October 3, a paper by Mr. P. H. Smith bearing this title was read and discussed. The author gave interesting details on the subject of tuning up an oil engine by means of pyrometers recording the exhaust temperature, the indicator card being used only for the purpose of adjusting the firing point and compression. In a table of exhaust temperatures and loads over a period of several years attention was drawn to the fact that when operating on tar oil the exhaust temperature appeared rather lower than with ordinary fuel oil, which suggested that exhaust temperature is also a function of viscosity of fuel, since tar oil is very much thinner than normal fuel oil.

Copies of the paper, together with an account of the discussion thereon, will, in due course, be obtainable on application to Mr. Percy Still, joint honorary secretary of the Diesel Engine Users' Association, at 19, Cadogan Gardens, London, S.W.3. It will undoubtedly interest every reader who is in charge of Diesel plant or working in a Diesel-driven station, as well as those employed in the ever-growing number of motor-driven vessels.

THE "M.O." VALVE WORKS.

An insight into the swift growth of the radio industry which has resulted from the introduction of the thermionic valve was given to a number of Press representatives who recently visited the works of the M.O. Valve Company, Ltd., and the joint selling companies (the General Electric Company, Ltd., and the Marconiphone Company, Ltd.), at Brook Green, Hammersmith. These companies have pooled their resources and experience, thus contributing to the present state of efficiency in broadcasting. Over 2,000 hands are employed at the works, about 550 being engaged in the production of the Marconi-Osram valves. It was through the agency of these valves that the first telephone communication across the Atlantic was established.

As most of our readers are aware, the thermionic valve was invented by Dr. Fleming in 1904. His patents were acquired by Marconi's Wireless Telegraph Co., Ltd., and a large amount of research work was carried out by that company in the application thereof, first of all, to the purposes of wireless reception, and more recently in connection with wireless transmission. The development of the thermionic valve, and of the wireless circuits in which it is used, has been a matter of the closest co-operation between the manufacturers of the valves and those engaged in their development and application to the purposes of wireless telegraphy. At first, each company proceeded along its own lines and gained its own separate experience. These experiences are now combined in the M.O. Valve Co., Ltd., which has the advantage of the research laboratories of the General Electric Co., and also of the wide experience of the Marconi Company's engineering and research staff.

It was during the war that the application and development of the valve was most rapid, and the G.E.C. devoted a proportion of their Osram lamp factory at Hammersmith to an investigation of the problems involved in valve manufacture, with the result that they produced huge quantities for the fighting services. Eventually, a separate manufacturing organisation—the M.O. Valve Co., Ltd.—was established, with a specialised factory at the Osram lamp works, and to-day the whole resources of this factory are engaged in supplying the demand for valves of all types, which are marketed under the brand *Marconi Osram Valves* by the joint selling companies—the General Electric Co., Ltd., and the Marconiphone Co., Ltd.

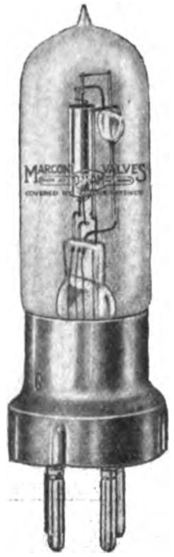


FIG. 1.
M.O. VALVE.
TYPE D.E.3.

It will be convenient, first of all, to follow through the processes in the manufacture of the smaller types of valve used for broadcast reception, and we will take as an example the well-known type D.E.3 valve. This valve (illustrated in Fig. 1) is a dull-emitter general purpose valve, the filament of which is rated to consume only about .06 amperes at 2.8 volts. In view of the extreme fineness of the filament and the very small clearances between filament, grid and plate, it affords an extremely interesting example of the skill of the operatives employed, and of the ingenuity of the machines specially designed and manufactured within the factory for this work.

As with an electric lamp, so with the valve, the preliminary operations result in the production of what is known as the "pinch" or "seal." A short length of glass tube, one end of which is expanded into a flange or bell-mouth, is clamped in a pinching machine, and through the tube are threaded four copper "leading-in" wires, to one end of each of which is attached a short length of special wire, and then a short piece of thicker wire, ultimately to become the supports for the filament, grid and plate. As soon as the wires are placed in position the tube begins to revolve, and the flames of a number of gas blow-lamps play upon the unflanged end. When the glass has become thoroughly softened, two arms rise up and squeeze it flat, tightly gripping the leading-in wires and forming an airtight seal, as shown in Fig. 2. The four supporting wires are next bent to the correct shape according to the type of valve to be made.

In certain cases, such as the D.E.3 valve, having a vertical filament, grid and plate, an extension of the supporting system is added at this stage, consisting of top supports for the grid, plate and filament, these being joined into a rigid unit, and at the same time insulated from each other by sealing them into a glass bead. This upper unit is attached to the lower portion by spot-welding the bottom of the upper filament support to one of the short filament supports.

In another portion of the works girls prepare grids, plates and filaments ready for mounting upon their supports. The grids are principally made upon a universal grid-making machine of ingenious design, in which the necessary number of turns of wire, correctly spaced, are wound on a mandril, and, by a simple motion of the operator's hand, spot-welded at every turn to the supporting wire. By substituting formers of various shapes these machines may be used for any type of grid. Another machine, recently developed, is entirely automatic, and, once set up, produces a continuous spiral, cuts off the correct length, and welds it to the supporting wire, dropping the completed grids into a container at the rate of a dozen or so a minute. The plates, whether of the cylindrical or flattened pattern, are bent to shape on accurately made formers, the joint being spot-welded. A longitudinal rib or support is also spot-welded on, as well as a short length of magnesium wire, the use of which will be explained at a later stage.

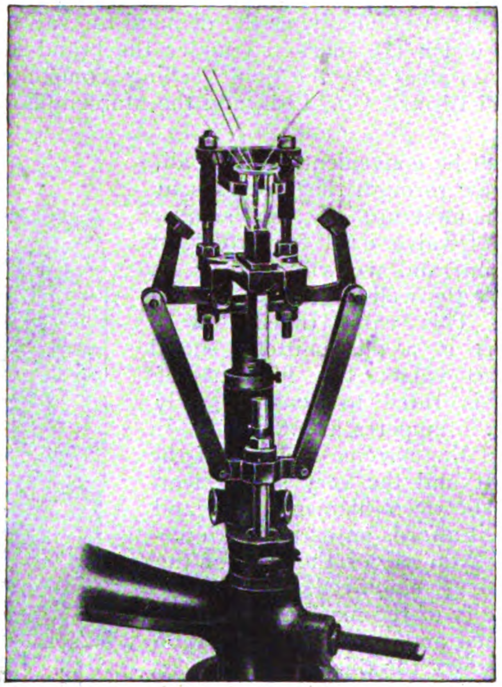


Fig. 2.—One Head of a Pinch-making Machine.

The assembly of these components upon their respective supports calls for the greatest accuracy and delicacy of touch. Naturally, jigs are extensively used for this and the previous operations, and great ingenuity has been shown in designing these devices wherein the components are brought into exact register with regard to each other and then swiftly and securely welded in position. A typical machine of this nature is shown in Fig 3. In the case of the D.E.3 valve, the grid and plate are fitted before the filament is inserted, both parts being slipped on to a mandril and welded at top and bottom to the supports.

The next process, "sealing-in," consists of inserting the seal, with its filament, plate and grid, into a bulb, to the top end of which has been attached a short glass tube through which the air will ultimately be exhausted. This process is performed on an ingenious machine in which the seal and bulb revolve and their point of junction is heated by gas flames until the two pieces of glass fuse together, and the excess portion of the neck, which drops by its own weight, is finally parted by a finely pointed flame.

The valve is now ready for exhausting, and for this purpose it is attached to the air pump by the exhaust tube previously attached to the bulb. The type of machine used for exhausting varies, many valves now being pumped on special automatic machines. Some valves, however, among which are the type D.E.3, are pumped some six at a time under conditions which allow the operator to exercise the greatest control over the delicate "gettering" process which completes the operation of exhausting. It is essential that a valve shall have a very much higher degree of vacuum than is necessary for an electric lamp. A difficulty here presents itself, in that comparatively large quantities of gas can be "occluded" or held by the metal parts of the valve *and the inner surface of the bulb.* For this reason it is necessary to raise these parts to a very high temperature to drive off as much of this gas as possible, and for this reason, too, the small piece of magnesium, previously mentioned, is welded to the plate. When the plate is raised to a high temperature the magnesium volatilises or "flashes," some of it combining with the small amount of gas remaining and thus "cleaning up" the vacuum, and the remainder being deposited in a fine mirror-like coating upon the inner surface of the glass, which will offer no hospitality to unwanted gas, and will also absorb any further quantity of gas which may be liberated from the metal parts during the life of the valve. Several methods of heating the plate and "flashing" the magnesium "getter" are adopted. That used for type D.E.3 valves is known as "eddy current heating." A coil of copper wire, through which a high tension current of very high frequency can be made to flow, is slipped over the bulb of the valve. The closing of the pump cage doors automatically switches on the high-frequency current, and in a few seconds the eddy currents induced in the plate have raised the metal to a temperature sufficiently high to flash the magnesium. Pump tables, with eddy current heating equipment, are shown in Fig. 4. Exhausting being completed, the lamps are sealed off and are now ready for the final processes. Dull-emitter valves, such as type D.E.3, have filaments of tungsten wire in which is a certain amount of

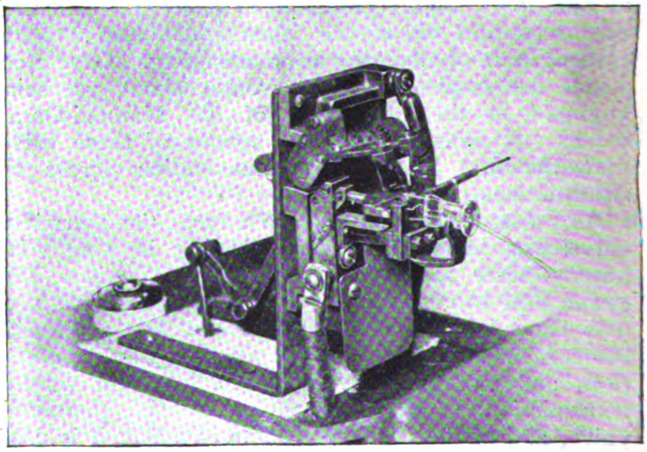


Fig. 3.—Spot-welding Apparatus for Assembly.

thoria, a substance which possesses the property of giving a very large electron emission at a comparatively low temperature. In order to bring a large quantity of the thoria to the surface of the filament, the valve is burned for a certain period at a definite temperature considerably in excess of the normal. The filament is next "aged" by burning at its rated temperature for a certain time, after which it is ready for the very exhaustive final tests.

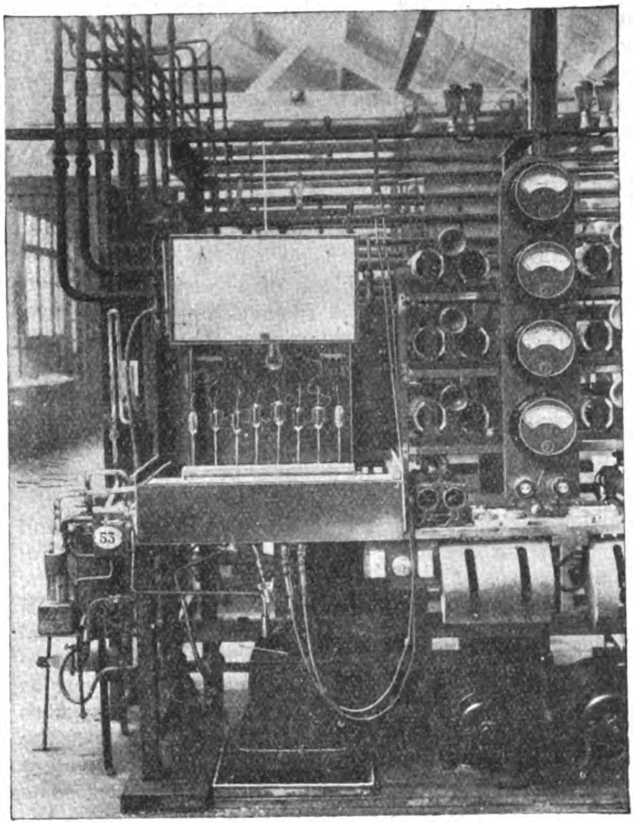


FIG. 4.—PUMP TABLES WITH EDDY CURRENT HEATING EQUIPMENT FOR FINE FILAMENT VALVES.

(*To be concluded.*)

Power Alcohol from Sugar Beet.—It is understood that some of the principal large users of motor spirit are pressing for favourable terms of sugar beets grown for the purpose of producing power alcohol on the lines of the privileges accorded to those used in the manufacture of sugar.

Annual Report.—We have received from H.M. Stationery Office a copy of the Report of the Committee on Scientific and Industrial Research for the year 1923-4, and a review of it will appear in these columns at an early date. The price is 3s. 4d., post free, from H.M. Stationery Office, or from the office of this paper.

Cambrian Correspondence School.—The 1924 edition of the *Annual Magazine* of the Cambrian Correspondence School has just been issued, and its perusal has afforded us much entertaining reading, as it sets forth very clearly the straightforward way in which Mr. Wm. Thomas, the Principal, conducts his tuition, the questions which are asked so far as concerns the electrical section, and the results which have been obtained by a very large percentage of the students scattered over all parts of Great Britain. The book will appeal to all enterprising students who may be thinking of taking up the study of electrical engineering in any of its varied branches, and copies will willingly be sent on application. It is worth writing for.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed on the top left-hand corner of all letters intended for this column.

QUESTION NO. 190.

I desire to find a fault on an underground cable. Are there other tests, other than Murray's loop test, which may be applied? If so, I would appreciate practical and technical details.—"D. WILLIAMS."

(*Replies to Question No.* 190 *must be received not later than October* 25, 1924.)

Answers to Questions.

REPLIES TO QUESTION NO. 183.

The second prize (5s.). has been awarded to Mr. L. J. Jennings, 210, Cradley Road, Netherton, Dudley, Worcestershire, for the following reply:—

The starter in question is described by "Astatic" as having an intermittent rating.

It is probably a type of starter that, when new, had a transfer on its side stating that it must not be used for starting a motor more than once in ten minutes. It is quite probable that this instruction has not always been carried out and that a coil has been burnt out of the resistance through overheating even though enclosed in oil.

The coils in this type of starter are usually held in a vertical position between two pieces of iron plate, the slate slab being fixed above the coils. Tappings are then taken from the various coils to the underside of the contact studs which protrude through the slab.

As a temporary measure and provided that the open circuit is limited to two contacts only, "Astatic" would be quite safe in bridging the studs themselves by soldering a piece of wire of 14 or 16 s.w.g. from one to the other. Obviously, if more than two contacts are affected bridging would not be satisfactory, as short circuiting several of the resistance coils would have the effect of starting the motor with a rush.

To make a permanent job "Astatic" should remove the nuts or bolts holding the starter in the iron case, and by lifting on the slate, raise until the coils are clear of the oil. Leave suspended in this position until as much oil as possible has dripped into the case, thus ensuring that very little is wasted.

Now examine for the cause of the trouble. It may be found that only the connection from the top of coil to the contact has broken, in which case it is only necessary to reconnect by bringing the broken end under the clamping nut, or, if found to be too short, by soldering or otherwise to joint a new piece of wire on to the coil, taking care that this connection is quite sound.

It may be that "Astatic" will find a simple break in the resistance wire itself. This can be remedied by joining the two ends and clamping them firmly with a small connector such as the terminal taken from an old switch or ceiling rose, care being taken that the joint does not touch any adjacent coils.

If, however, a coil is entirely burnt out, "Astatic" should either get a new one from the makers of the starter or wind one himself, but in taking out and replacing he would be wise to get a little help, as in many of this type of starter all the coils fall from their positions on removing one of them, and getting perhaps a dozen coils into a dozen holes at the same time is rather a trying proposition.

On replacing the starter in iron case, "Astatic" should see that the oil is sufficient to keep the coils covered.

A HUNDRED YEARS OF ELECTRICAL ENGINEERING.*

(Continued from page 526.)

One of the earliest complete house-lighting installations was put in by Kelvin in 1881. A Clerk gas-engine was used to drive a Siemens dynamo, a battery of Faure cells was fitted up, and every gas-light in his house and laboratory at Glasgow University was replaced by 16 candle-power Swan lamps for 85 volts. He had to design his own switches and fuses, etc., for such things were almost unknown.

For about twenty years the carbon-filament lamp held the field without a rival for interior illumination, and, although attempts were made to improve its efficiency by coating the filament with silicon, the plain carbon filament only gave way finally to the metal-filament lamp. One of the most interesting developments in the history of electric lighting was the Nernst lamp, which was introduced in 1897; the filament consisted of a mixture of zirconia and yttria, and not only had to be heated before it became conducting but also had to be connected in series with a ballast resistance in order that it might burn stably. The way in which these difficulties were surmounted and the lamp, complete with heater, ballast resistance, and automatic cut-out, put on the market in a compact form occupying little more space than the carbon-filament lamp was, in my opinion, a triumph of applied science and industrial research. The efficiency was about double that of the carbon lamp. About this time, however, a return was made to the long-neglected metal filament. The osmium lamp invented by Welsbach in 1898 was put on the market in 1902, to be followed two years later by the tantalum and tungsten lamps. The latter was greatly improved by the discovery in 1909 of the method of producing ductile tungsten and by the subsequent development of gasfilled lamps in which the filament can be run at such a temperature without undue volatilisation that the consumption is reduced in the larger sizes to 0.6 watt per mean spherical candle-power. This improvement of eight times as compared with the efficiency of the carbon-filament lamp has led to the gradual replacement of the arc lamp even for outdoor illumination. The arc lamp was introduced at about the same time as the carbon-filament lamp, the Avenue de l'Opéra having been lit with Jablochkoff candles in 1878. The open arc was developed during the 'eighties; the enclosed arc, giving long burning hours and thus reducing the cost of re-carboning, was introduced in 1893, and the flame arc in 1899. During the first few years of this century the flame arc was brought to a high stage of development and the consumption brought down to about 0.25 watt per candle-power, but the necessity of frequent cleaning to prevent the reduction of efficiency by dirt and the labour of recarboning have led to its abandonment in favour of the less efficient filament lamp.

Before leaving the subject of electric lighting, I would point out that it is remarkable that the first great application of electric power should have been for the production of electric light, since it is probably the least efficient of all its applications. The overall efficiency of a small power station supplying a lighting load, and having therefore a very poor load factor, would not be greater than about 6 per cent. from coal to switchboard, the steam engine being, of course, the principle offender. Of the total power supplied to and radiated from a carbon-filament lamp not more than about 2 per cent. was radiated as light, so that the overall efficiency from coal to light was 2 per cent. of 6 per cent., which means that of every ton of coal burned at the power station with the object of producing light all but about 3 lb. was lost as heat at various stages of the transformation. Even now, with up-to-date steam plant and gas-filled lamps, the overall efficiency from coal to light is not equivalent to more than 40 to 60 lb. of coal out of each ton. The electrical engineer may derive a little comfort from the knowledge that the purely electrical links are the most efficient in the chain.

Whilst on the subject of efficiency, I might point out that the difference between the prices at which coal and electrical energy can be purchased by the ordinary citizen corresponds to the losses incurred in the power station; that is to say, that the cost of the generation and distribution of the electrical energy is covered by the better terms on which the power station can obtain fuel. In Glasgow the writer pays £5 per ton for anthracite to burn in a slow-combustion stove; taking the calorific value of anthracite at 9,000 kilowatt-hours per ton, which is equivalent to 14,000 British thermal units per lb., this works out at 7½ kilowatt-hours for a penny. For electrical energy for heating and cooking purposes the writer pays a penny per kilowatt-hour. The ratio of 1 to 7½ will correspond fairly closely to the overall efficiency of the power station. In view of the high efficiency and convenience of slow-combustion stoves, it is evident that electric heating cannot be expected to compete with them for continuous operation; for intermittent heating the question is very different.

Returning from this digression to the development of the direct-current dynamo, it may be noted that the drum armature now almost exclusively employed was invented in 1872 by von Hefner Alteneck, and gradually displaced the ring armature of Pacinotti and Gramme. Although Pacinotti's original ring armature was slotted smooth armatures were preferred for many years, until the mechanical superiority of the slotted armature caused the disappearance of the smooth core with its wooden driving pegs which were employed to transmit the turning moment from the conductors to the core. The commutator and brushes were a great source of trouble, but by the gradual elimination of unsuitable material and by better design and methods of manufacture the commutator has been made a most reliable piece of apparatus. The difficulties of commutation, and especially the need of continual adjustment of the brush position, were largely overcome by the invention of the carbon brush by Professor George Forbes in 1885. It should be pointed out that the commutating poles, which have come into use so much in recent years, were originally suggested in 1884, and are therefore older than the carbon brush.

---

* Address before the British Association, at Toronto, by Professor G. W. O. Howe, D.Sc., President of Section G.—Engineering.

The realisation of the idea of supplying electric current from a power station for lighting houses in the neighbourhood owed much to the energy and business ability of Mr. Edison. He exhibited his first "Jumbo" steam-driven dynamo in 1881, and installed two sets at Holborn Viaduct in the following year to supply current to neighbouring premises. The output of these sets was about 90 kilowatts at 110 volts, which was so much larger than anything previously constructed that the name "Jumbo" was applied to these sets. About 1890 the multipolar type began to replace the bipolar type for the larger sizes. The size of the single units employed in power stations gradually increased with the increasing demand, and by 1895 dynamos of 1,500 kilowatts had been installed.

(*To be continued.*)

Reviews of Books, &c.

[Books noticed in this column will be sent from ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

TELEPHOTOGRAPHY. By Cyril F. Lan-Davis, F.R.P.S. (Routledge, 3s. 6d. net.)—This new third edition of the above work is edited by Israel Davis, M.A., as the original author's death is assumed to have taken place on October 4, 1915, after very valuable work in the Air Service.

Although the book has been brought up to date, the original plan conceived by the author has not been interfered with, the chief alteration being in the chapter dealing with commercial types of telephoto lenses. The amateur photographer will be led step by step through the theory and practice of telephotography, a branch of the science that is becoming increasingly popular and each day more necessary. The book is essentially practical, and the author has the ability of imparting his expert knowledge on the subject in a direct and emphatic way, and, while mathematics are a minimum, sufficient formulæ are given to cover the effective working of telephoto lenses.

The illustrations show in a very striking way the value of telephotography, not only for the use of the explorer or naturalist, but for the engineer and the architect. To the ordinary camera worker, the book should also be of value, because the use of the telephoto lens makes it imperative that such matters as vibration, camera tilt, wind, etc., should be given due consideration. As we have to look at the book from an engineering standpoint, we are struck with the fact that small objects may be photographed in order to produce full-size or enlarged images much more satisfactorily with a telephoto lens than by the use of an ordinary objective, and to engineers, or the publicity departments of engineering firms, this point is recommended.

The new edition is well worth while, and has been very ably carried out by its new editor.

AUTOMATIC TELEPHONE SYSTEMS. By W. Aitken, M.I.E.E. (Ernest Benn, 55s. net.)—This third and final volume of the series by this well-known authority on telephony completes a very valuable compilation of the principal modern telephone developments of the present age.

From the telephone engineer's standpoint it is probably the most interesting volume of the series, inasmuch as it deals with large multi-office automatic systems; semi-automatic working; miscellaneous systems; lay-out and wiring; power plant; and traffic.

So rapid is the latest development in automatic telephony for large cities, culminating in the adoption of the Strowger Director Automatic System for Greater London, that it is practically impossible for an author to keep pace with the progress in detail design and circuits, since the interval between the passing of the final manuscript to the printers and the issue in book form to the public is sufficient to introduce quite a number of important improvements.

In the circumstances it is not surprising that the description and accompanying illustrations of the Strowger Director are not quite up to date. The latest type of Director unit is not shown, nor is its associated translator, whilst the lettered and numbered dial plate illustrated is one which has since been abandoned in favour of a different arrangement of the alphabet.

Nevertheless the section dealing with this all-important feature is replete with useful and instructive information which should prove invaluable to Post Office engineers and others responsible for introducing the Strowger Automatic System into our larger cities and towns.

The Western Electric Panel System is very fully dealt with as is also the lesser known Ericsson System. The call indicator and impulse sending mechanism, key sending, etc., are well analysed, and these sections will also appeal to telephone men during the transition period from manual to automatic working.

There is a large quantity of information on miscellaneous subjects of more or less direct interest to telephone engineers and students at the present juncture, and the book should figure in the reference library of every telephone manufacturer and operating company or administration, although we fear its comparatively high price will militate against a more general circulation among students and junior engineers of limited means.

The standard system of circuit routing is adhered to in the present volume, and, due to their size, it has been found necessary to introduce double folds into some of the inset diagrams. In this connection it is unfortunate that modern automatic telephone circuit diagrams tend to grow unduly complex, making them rather difficult to read and follow clearly unless of considerable dimensions.

Tenders Accepted.—The Mile End Board of Guardians have accepted the tender of the G.E. Co. for six months' supplies of Osram metal filament, vacuum and gasfilled lamps, also Robertson carbon filament lamps.

Various Items.

Tenders Accepted.—The G.P.O. and H.M. Office of Works have accepted the tenders of the Edison Swan Electric Co., Ltd., for twelve months' requirements of incandescent electric lamps.

Meetings.—The Inst. of Heating and Ventilating Engineers will meet at Caxton Hall on Tuesday, October 14, at 7 p.m., when Mr. H. A. Stirzaker will read a paper on "Safety Valves."

N.A.S.E. Scholarships.—The Examining Board have now issued their decisions regarding the second annual competition, and have awarded scholarships of three years' duration, value £7 each, to Mr. T. V. Harding, of West Thurrock, and Mr. W. Harvey, of Catford.

Removal.—Owing to increasing business in the South Wales area, Messrs. Johnson and Phillips, Ltd., have removed their Cardiff branch offices and stores from 2A, Court Road, to more commodious premises at 10, Westgate Street, Cardiff. The telephone number will remain as before, *i.e.*, Cardiff 1937.

English Church at Ypres.—An appeal is being made for funds to build an English church at Ypres, where the large number of pilgrims who go all the year round from our islands and Dominions to visit the graves of our armies in Flanders can come for prayer and remembrance of their dead. Subscriptions should be sent to Bishop Bury, c/o the Rev. B. Staunton Batty, Commissary, Christ Church Vicarage, Down Street, London, W.1.

Society of Engineers.—The July-September issue of the *Journal of Transactions* of this Society contains some interesting articles which will appeal to electrical readers generally, including a good paper on "Welding and its Applications to Bridge Work," by Mr. J. B. Scholefield, A.M.S.E., as well as one on "Co-operation between the Engineer and the Works Chemist," by Mr. A. R. Page. The price of the journal is 5s., post free.

The Engineers' Club.—During October the following meetings will be held in the club, viz., 13th, London Section of the Inst. of Brewing; 15th, Inst. of Motor Traders; 16th, Inst. of Mining and Metallurgy, Council Club dinner; 17th, Inst. of Aeronautical Engineers; 21st, British Cold Storage and Ice Assoc.; 23rd, Inst. of Welding Engineers; Chemical Engineering Group; 25th, British Association of Chemists; 28th, Inst. of Production Engineers; 30th, Inst. of Locomotive Engineers.

Institute of Patentees.—The following lectures have been arranged for the present session—viz.: November 6, "Inventors' Dreams and Commercial Facts," by Mr. R. F. Tunmer; December 11, "Inventor and Invention," by Mr. W. J. Dow; January 8, "The Evolution of the Motor-car Engine," by Prof. A. M. Low, D.Sc., A.C.G.I., M.I.A.E., F.C.S.; February 12, "A Talk on Wireless," by Capt. P. P. Eckersley; March 12, "How to Approach a Manufacturer," by Mr. J. G. Sutton. The above lectures will be held at 8 p.m. in the Engineers' Club, Coventry Street, on the dates indicated. The President, Sir William Grey-Wilson, K.C.M.G., K.B.E., will be in the chair.

Personal.—Mr. J. F. Caine, asst. sales manager to Siemens and English Electric Lamp Co., Ltd., has resigned his position with the company to enter a new sphere of activity as a farmer at Northover, Steyning, Sussex. Mr. Caine has been in the service of the company since the amalgamation in 1920 with the English Electric Supplies Co., with whom he had been associated since its inception, and previous to that as director of the Britannia Lamp and Accessories Co., Ltd. On his resignation he was entertained at luncheon by the staff at the Holborn Restaurant, and was presented with a grandfather clock from the staffs in London and with a solid silver candelabra from the company's branches. Mr. Caine was a very popular member of the staff, and although he is leaving he will always be remembered for the keen interest he took in the social as well as the business side.——Mr. J. B. Alexander has resigned from the position of managing director of Ebonestos Insulators, Ltd., and has disposed of all his interests in the company, after having been connected with it since its inception about 25 years ago.

The Recent Gales.—Numerous aerial masts were put out of action during the recent gales through Great Britain, and the pioneer wireless insurance company (Liverpool Marine and General) inform us that more claims have arisen therefrom than at any other time. Every gale brings a fresh crop of disasters.

Social.—The Batti-Wallah's Society is about to commence this season's functions. The reunion meeting was a luncheon held at the Hotel Cecil on Wednesday, October 8, at 1 p.m., in order to introduce to the members the gentlemen who have become Batti-Wallahs during 1924. The chief guest at this luncheon was Mr. K. A. Scott Moncrieff.

Belfast.—The 30,000-ton Holland-America liner *Statendam*, recently launched at Belfast, is the largest vessel launched from a British shipyard since the Great War, and is also the biggest ship at present under construction. The electrical installation will be one of the largest installed on board ship, and will be in keeping with latest experience.

Dublin.—At a special meeting last week of the Dublin County Council, to consider a resolution regarding the Dublin Electricity Bill, the East Leinster United Electricity Supply Bill, the Dublin United Tramways Company (1896), Ltd., Bill, and the Dublin and District Electricity Supply Bill, a motion was proposed by Mr. Curran, seconded by Mr. Beckett, to oppose these Bills in the Oireachtas, the cost of such opposition to be payable out of the poor rates levied in the county. The resolution was passed unanimously.

Meetings.—The Junior Inst. of Engineers will meet on Friday, the 10th inst., at 39, Victoria St. Paper, "The Design of Static Sub-stations, with Some Notes on Their Equipment," by N. Thornton, A.M.I.E.E. (Member). Slides. Also on Friday, the 17th inst., at the Royal Society of Arts, John St., Adelphi. Special meeting. Lecture, "High-voltage Electric Oscillations," by R. P. Howgrave-Graham, M.I.E.E. (of the Northampton Polytechnic Institute). On Friday, the 24th inst., at 39, Victoria St., lecturette, "Powdered Fuel," by F. F. Evans (Member), and on Friday, the 31st inst., at 39, Victoria St., lecturette, "Audio-frequency Transformers," by H. J. N. Riddle (Associate Member). All at 7.30 p.m.

Excursion to Wembley.—On Saturday, October 4, three special trains were chartered to convey some of the employees of British Insulated and Helsby Cables, Ltd., Prescot Factory, on the occasion of the firm's excursion to the British Empire Exhibition. The trains left Prescot, Lancashire, at 4.35 a.m., and breakfast was provided *en route*. The party, wearing the distinctive "B.I." trade mark as badges, arrived at about 10.15 a.m. Lunch was taken in the Exhibition grounds at noon, and ample opportunity was afforded for a comprehensive tour before the return trains left at 1.45 next morning, a hot supper being provided on the way home. The excursion was organised with a thoroughness typical of this world-famous cable-making concern, and was voted an immense success by a tired but very cheerful party.

Trade Notes.

Evershed and Vignoles, Ltd., of Acton Lane Works, Chiswick, London, W.4, have issued a new edition of their Ducter catalogue, which is very similar to the former editions, but in it the theoretical description of the principle on which this instrument works has been simplified, and the section dealing with applications lengthened and brought up to date. This latter section is really a most interesting set of working instructions covering several leading industries, and will appeal to all engaged therein who have to carry out low resistance tests. They should therefore write for it.

Messrs. A. W. Beuttell, Ltd., of 53, Victoria St., London, S.W.1, have issued List No. 24 dealing with Linolite reflectors for showcase, cornice and picture lighting and also the Little Giant reflector for shop-window lighting. It should appeal to all installation contractors, and copies will willingly be sent on application.

WINCHES
THE LONDON ELECTRIC FIRM, CROYDON
FOR ARC LAMPS THEATRE BATTENS WAREHOUSES ETC.

REGD. Vulmos GENUINE VULCANIZED FIBRE
MOSSES & MITCHELL, LTD. 122 & 124 GOLDEN LANE LONDON, E.C.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

OCTOBER 17, 1924.

CONTENTS.

CONTENTS.	PAGE
Electricity Supply Developments in Great Britain	557
The "M.O." Valve Works	559
Correspondence	560
Current Topics	563
Practical Electrical Engineering Hints	565
Electrical Installation Work	566
The Design of Static Sub-Stations	566
A Hundred Years of Electrical Engineering	567
A Record Transport Feat	568
Electric Motors	569
Various Items	570

ELECTRICITY SUPPLY DEVELOPMENTS IN GREAT BRITAIN.

The year ending March 31, 1924, covered by the Fourth Annual Report of the Electricity Commissioners,* witnessed a further substantial improvement in the general output and financial position of electricity supply undertakings throughout the country. The general reduction in the cost of generation and in the charges for electricity, which was a marked feature of the preceding year, was followed by further similar reductions in many parts of the country during the year 1923-24, with results beneficial to the supply undertakings themselves and also to industrial and domestic consumers generally. The wider demand for supplies for all purposes gives evidence of material improvement in general trade conditions, and from a broad review of the position it can be said that the supply industry has substantially recovered from the reaction occasioned by adverse trade conditions. Also, the supply industry has contributed in an important measure to the provision of employment in allied trades.

Nearly 80 per cent. of the population of England and Wales is concentrated in an area representing only about 11 per cent. of the total area of these countries, the average population in these districts being 4,615 per square mile. The other 20 per cent. of the population is distributed over the remaining 89 per cent. of the total area of the country, where the average density of population is only 151 per square mile, or less than one-thirtieth of that of the remainder of England and Wales. These figures give a clear indication of the governing factor in establishing remunerative supplies of electricity in rural districts. General supplies are available or in process of establishment in areas in England and Wales having a population of about 28 million, or, say, 74 per cent. of the total population of the country. There are, however, no less than 50 municipal boroughs and urban districts with populations of 10,000 or over in which general supplies have not yet been authorised.

From the analysis and summaries of the returns of fuel consumption and units generated in 541 generating stations,* it appears that the total output showed an increase of nearly 943 million units, or 16.4 per cent., compared with the previous year, whereas the total consumption of fuel increased by only 11.3 per cent. The average consumption of fuel in steam stations was reduced from 2.78 lb. to 2.67 lb. per unit generated, *i.e.*, a saving of about 4 per cent.; and at oil stations from 1.72 lb. to 1.49 lb. per unit, or a saving of 13.3 per cent. The average fuel consumption in gas-producer stations also showed a decrease from 2.70 to 2.63 lb. per unit, or 2.6 per cent. reduction.

In the group of stations generating more than 200 million units per annum the average fuel consumption was 1.06 lb. per unit in steam stations, the lowest figure being 1.81 lb. at the Carville B station, and the highest thermal efficiency being 17.47 per cent. (at the Glasgow Corporation station). The best results for the whole country are obtained at the Barton (Manchester) station, which commenced supply on October 11, 1923. This station comes in the group generating between 50 million and 100 million units per annum, and its fuel consumption is 1.48 lb. per unit and its thermal efficiency 20.33 per cent. As showing how far these figures are in advance of those obtained in some other stations it may be mentioned that the average fuel consumption per unit generated in stations producing under 50,000 units per annum is no less than 36.3 lb. per unit, and, according to these returns, the highest thermal efficiency attained in a group of seven stations producing between 50,000 and 100,000 units per annum is 2.96 per cent. !

It is pointed out by the Electricity Commissioners in their annual report that, if the whole of the units generated during the year under review had been produced at modern and efficient stations with an average consumption of, say, 2 lb. of coal per unit generated, the total consumption of coal would have been about 6,000,000 tons, representing a saving of some 20 per cent. on the actual consumption; alternatively, for the same actual consumption the total output could have been increased by over 26 per cent. These figures emphasise the scope of the further economies open to be achieved by the centralisation of generation in the various electricity districts.

The extent to which the public supply of electricity in Great Britain is at present dependent upon a multiplicity of generating stations, mainly of small size, is illustrated by the fact that of the 541 stations submitting returns, 224, or 41 per cent., generated less than 1,000,000 units each, while 398, or 73 per cent., of the stations generated less than 10,000,000 units each per annum. There is clearly great scope for reorganisation on lines which will lead to the more economical production of electricity by concentrating the generation in fewer well-placed interconnected stations, thus leading to the supersession of many of the small and non-economical stations, both public and private, as cheaper and reliable supplies become available from the centralised systems. Since the establishment of the Commissioners, local generation at 37 small stations has been replaced by bulk supplies, and in a dozen other instances similar stations have been relegated to the position of standby sources of supply only. This desirable process, says the Commissioners, needs to be accelerated.

---

* 146 pp. and folding maps, H.M. Stationery Office (or from ELECTRICITY Offices), 3s. net, 3s. 4d. post free.

* "Analysis and Summaries of Fuel Consumption, etc., Returns for the Year ending March 31, 1924." From H.M. Stationery Office (or Rentell, 36, Maiden Lane, Strand, W.C.2). 1s. 6d. net, 1s. 9d. post free.

A broad exception should be made, however, in the case of small stations utilising water power, as these may be expected to remain in operation under any scheme of reorganisation. Moreover, the establishment of comprehensive transmission and distribution systems over wider areas than hitherto will undoubtedly lead to the development of further water power at sites which are at present too far from load centres to be of immediate practical utility; also it will lead to the remodelling of many small water-power sites which were formerly used for the development of industrial power, but have since become disused. So far as the records available to the Commissioners are concerned, only 27 of the undertakings derived supplies from water power during the past year. The total capacity of the water-power plant in these stations was 13,825 kw., and in only eight cases was the capacity of the hydro-electric plant in excess of 100 kw. The largest water-power station owned by an authorised undertaker in Great Britain is that of the North Wales Power Company, Cwm Dyli, the installed capacity being there 5,500 kw. Parliamentary powers have, however, been obtained for three important developments in Scotland, namely, the Lochaber scheme, estimated to give 70,000 continuous h.p. at Fort William; the Grampian scheme, estimated to give 56,000 continuous h.p.; and the Loch Doon development, estimated to give 1,010 continuous h.p. Powers are also being sought for developing from 6,500 kw. to 13,000 kw., at various times of the year, from the Falls of Clyde.

As compared with the figure for 1922, the sales of electricity during 1923 showed an increase of 19 per cent. and amounted to an average consumption of about 100 units per head of population in the whole of Great Britain. If the figures for England and Wales alone be considered, the sales in 1923 represented about 130 units per head of population in these areas. It is important to note that these figures relate only to supplies sold by authorised undertakers, and do not include the large supplies generated for traction and other purposes by railway companies, railway authorities and non-statutory undertakings. Also, there is a very large amount of private generating plant in various manufacturing and trading establishments, and it is estimated that supplies from private plant probably represent the equivalent of half the total supply taken from all the public utility stations (including railway and tramway and non-statutory generating stations, which themselves generate units amounting to about 25 per cent. of the number generated in the stations of authorised undertakers). Allowing for these facts, it may be taken that the consumption of electricity for all purposes in Great Britain at the present time is in the neighbourhood of 200 units or more per annum per head of population. This figure, it will be noted, compares very favourably with the estimate of 60 units per head per annum given in the Report of Mr. Lloyd George's Committee on "Coal and Power," in 1920. From the Commissioners' figures, which are of unquestionable reliability, it is evident that the figure given by the Lloyd George Committee was a serious under-estimate, and one which implied that the position of the electrical industry in this country was in a much less favourable position, compared with that of the United States, than was actually the case.

In their general observations relating to the reorganisation of electricity supply in this country, the Commissioners state that it is generally conceded that the maximum economies and most efficient service throughout a wide area can only be achieved when the generation of electricity for that area has become concentrated in a comparatively small number of modern, well-placed and electrically interconnected stations from which the needs of all portions of the area within an economical radius of transmission can be met by means of bulk supplies.* Under the régime contemplated by the Electricity Supply Act of 1919, the principal method whereby centralisation of generation can be effected in a large district containing a number of authorised undertakers is by the transfer of the appropriate stations and transmission and interconnecting lines to a joint electricity authority. Unfortunately, the process of reorganisation has, so far, been retarded by the pronounced desire on the part of the majority of authorised undertakers to retain the ownership and control of their generating stations and to extend the latter up to the limit of the capacity of the sites, whether well adapted or not for modern methods of generation.

As matters now stand, improvements in large electricity districts where substantial undertakings have already been established can only proceed by way of individual development unless and until joint electricity authorities are established with the necessary executive and financial powers. Comprehensive schemes of the character in question naturally involve the expenditure of capital in advance of immediate requirements, either in the construction of new stations or the laying of new transmission lines.

Some measure of improvement has been effected by co-operative action under the schemes now in operation, but the degree of fusion of interests in the generation and transmission of electricity which is essential to bring about thorough organisation has still to be attained. Adequate reorganisation cannot be effected so long as there is a tendency to submit schemes which attempt to reconcile reorganisation with the practically undisturbed operation of established undertakings. Failing the early disappearance of the obstacles which have hitherto retarded progress, "the whole position will call for review." In other words, if there is not displayed the united effort and willingness to pool resources for the common good, by which means alone there can be brought about a cheapening of supply and extension of public supplies for all purposes, then further legislation will be required and, we doubt not, will be forthcoming. Though it may take time to do so, the parish-pump attitude towards electricity supply must, and will, be broken down—and the sooner the better for all concerned.

---

* This statement, as made, is one with which every electrical engineer will agree; but it is well to bear in mind that the smallest generating plant which has a suitable application for its waste heat—either in heating service or in process work, etc.—can realise a higher overall thermal efficiency than can be obtained in even the largest super-station which operates condensing without making use of the 60 per cent. or so of the total heat of the fuel burnt which is rejected in the condenser. Methods of utilising low-grade heat are attracting more and more attention in America and on the Continent, and it appears to us that the Commissioners might give a valuable lead to the industry in this country by discussing this matter in detail in their next report. Centralisation alone, without utilisation of low-grade heat, does not represent the highest efficiency to which we can at present aspire. Readers desiring further information on this phase of the subject should study the power-station chapters in *Electrical Engineering Practice*, by J. W. Meares and R. E. Neale (Electricity Offices, 25s. net).—Ed.

In concluding our remarks upon this valuable report, which deserves to be studied carefully by all those who are interested in the development of electricity supply, we may mention that the greater part of the publication is devoted to a review of action taken by the Commissioners in connection with specific supply undertakings and particular problems relating to the generation, distribution and sale of electricity.

THE "M.O." VALVE WORKS.

(*Concluded from page* 553.)

The elaborate arrangements for testing every valve made at the M.O. valve works are worthy of particular note, for it is only in this way that the company are able to accomplish the supreme achievement of producing commercially, in bulk, valves of absolutely standardised performance. A specially trained testing staff is employed to examine every valve. The valves are put on circuit and tested for filament consumption for emission at set conditions and for impedance. Finally, a micro-ammeter gives a reading of the maximum reverse grid current or "backlash." The equipment of the test tables is shown in Fig. 5. Having successfully passed these tests, the valve is passed to benches for capping, marking and packing. Even in these last two operations high organisation is recognised, for each individual valve is marked with a separate serial number, which number also appears on its purple carton. By this number, with works and sales records, it is possible to trace the complete history of any valve both in the factory and after issue.

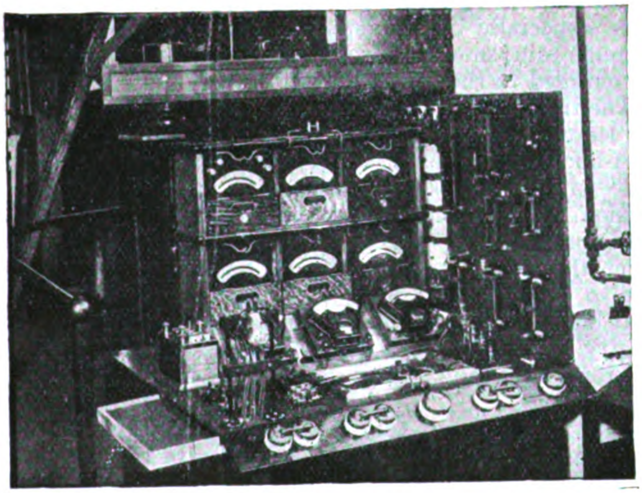


FIG. 5.—TEST TABLE.

Naturally, in an article like the present one, it is impossible to deal exhaustively with the subject of valve manufacture, especially in view of the large number of valve types which are being produced from these works. Nearly two dozen standard types of small valves for broadcast reception and low-power transmission are listed, and there are hosts of special types for the Army, Navy, Air Force, Post Office and other services. In addition, the manufacture of high-power rectifying and transmitting valves is undertaken, these including large rectifiers made for the General Electric Co., Ltd., and capable of dealing with small currents at 150,000 volts, such as are necessary in cable testing, in the electrical precipitation of dust, and other processes. Large water-cooled transmitting valves (Fig. 6) are also built for Marconi Wireless Telegraph Co., Ltd., in sizes taking an input of from 10 to 20 kw. It is interesting to note that the high-power broadcasting stations at Chelmsford and Ongar, photographs of which are reproduced in Figs. 7 and 8, are equipped with these valves.

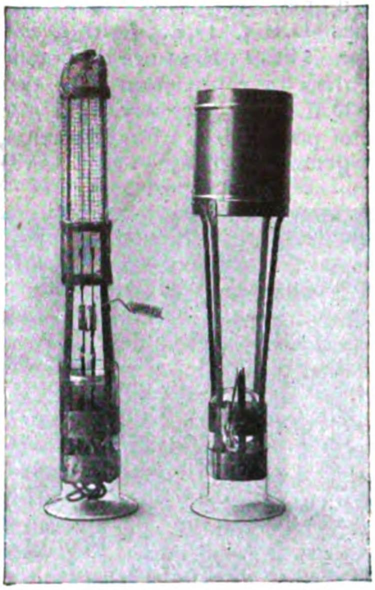


FIG. 6.—ELECTRODES FOR A TYPICAL TRANSMITTING VALVE.

The principal types of broadcasting valves produced by the M.O. Valve Co., Ltd., fall into four sections: general purpose valves, H.F. and detecting valves,

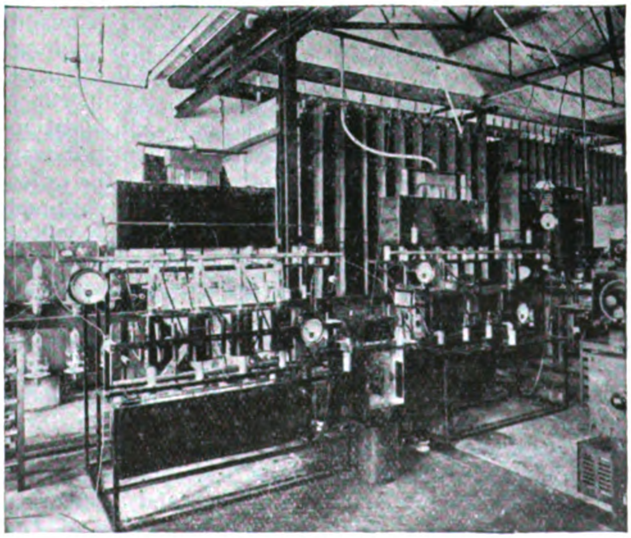


FIG. 7.—WATER-COOLED VALVES IN USE IN THE EXPERIMENTAL HIGH-POWER BROADCASTING STATION (5X.X.) AT THE MARCONI WORKS, CHELMSFORD, ESSEX.

amplifying valves and small transmitting valves. In the first category are types R and R5 volt bright emitters, and types D.E.R. and D.E.3, which are dull emitters. These valves will function satisfactorily as high and low frequency amplifiers and also as detectors, provided the relative grid and plate potentials are appropriately adjusted. Among low-frequency amplifying valves a new series of dull-emitter power amplifiers, types D.E.4, D.E.5 and D.E.6, deserve special mention. These valves are designed for use as loud-speaker valves in conjunction with types D.E.3, R. 5-volt and D.E.R. respectively, and give a much greater output of power, free from distortion, than the corresponding general purpose valve. While these valves are loud-speaker valves par excellence, they give, however, excellent results as high-frequency amplifiers or detectors. Type D.E.5B. is a valve specially designed for use in resistance-capacity coupled amplifiers. In this type of coupling, which is gaining considerable favour for distortionless amplification of signals for loud-speaker work, etc., the step-up effect of the transformers is lost, and the only amplification is that obtained in the valve itself. When ordinary type valves having an amplification factor of the order of 7 are employed in this circuit, purity is only obtained at great sacrifice of volume. The type D.E.5B. valve, however, has the very high amplification factor of 20, thus removing this drawback of the resistance-capacity method of coupling. A series of small transmitting valves capable of dissipating up to 50 watts at the anode are also made, these being particularly suitable for broadcasting and for use in amateur work and for low-power transmitting stations.

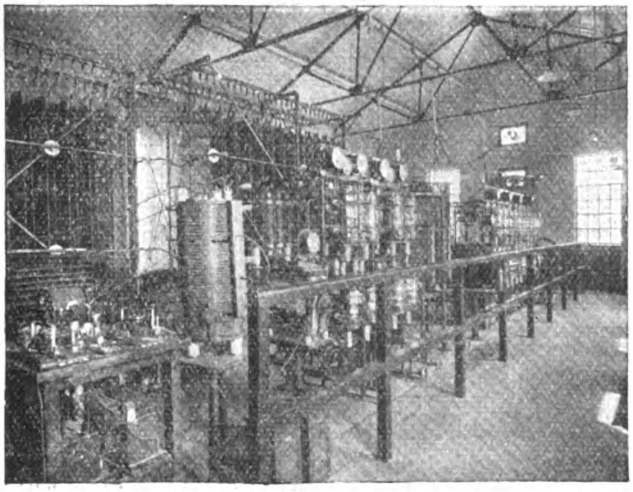


Fig. 8.—High-Power Transmitting Valves in Use at the Marconi Transatlantic Wireless Station at Ongar, Essex, for Communication with Canada.

After the tour of the works, Mr. C. Wilson, managing director of the M.O. Valve Co., presided at a luncheon, and in the course of a clear and interesting speech he remarked that an indirect effect of the development of the thermionic valve consequent upon the popularisation of wireless will probably be a more efficient and cheaper trunk telephone system. He said: "The Post Office has taken up our valves in connection with their repeater station, and the system will change the whole of the trunk-line service. It will not only increase efficiency by adding to the clearness of transmission, but, what is equally important, will very much cheapen the installation of trunk lines." As a matter of fact, no one can foresee the ultimate end of the valve service. Other developments loomed ahead, and girls who were taken out of the lamp works as semi-skilled workers were now engaged as skilled workers on the manufacture of valves, at a wage exceeding that of the ordinary engineer of to-day. The girls had been able to adapt themselves to the work, and the firm was pleased with the results.

Correspondence.

THE HIGH PRICE OF TEXT-BOOKS.

To the Editor of Electricity.

Sir,—At this time of the year students in technical schools and colleges are beginning to settle down to a hard session's work. Enthusiasm is great, since every student hopes that, at the end of the session, he will be nearer the goal of his ambitions—to become a qualified electrical engineer.

The magnitude of this enthusiasn can be realised when it is remembered that these students attend their school or polytechnic after—in many cases—a hard day's work. It requires an enormous amount of enthusiasm to attend lectures and lab. classes in the winter time, especially by students who have to travel miles through rain, snow and frost. Such students should be encouraged to the fullest extent.

The training of a student, however, does not end with his lectures and lab. work. In addition, he must have text-books from which he must study at home if he is successfully to pass the examination at the end of the session. I must complain that in this direction students are not receiving the encouragement they deserve, since the high price of technical books prohibit their use so that students have to "make shift" with old text-books which, since the electrical engineering industry has made such rapid strides in development, are totally inadequate and do not meet modern requirements.

I would point out that the high price of text-books is a great handicap upon the efficiency of the training of students. It is a handicap upon the teacher and, therefore, a distinct drag upon all who are responsible for the training of the electrical engineer.

I was looking through a catalogue of text-books the other day and I find that suitable works for a second-year electrical engineering student will cost almost £2. In the majority of cases students and their parents have not this amount of money to spare for books in these hard times. The result is that they cannot study to the extent of their abilities, and knowledge is lost to them for ever.

Please will you tell me why the price of text-books is so high?

Yours faithfully,
Cyril Sylvester, A.M.I.E.E., A.M.I.Mech.E.
Brixton, S.W.9.

If you are going to help run the country you mustn't be too tired to walk to the poll.

If you are ashamed of your politics it's time to change them.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of

CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N. 17.

TO OUR READERS.

Electricity is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited, and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. Rentell & Co., Ltd., 36–39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

A Transport Problem.

The increasing size and power of modern generating units in consonance with the development of the super power station idea is creating new problems in connection with the transport of these large and heavy masses of machinery from the point of manufacture to their ultimate destination. Unlike other machinery, structural steel work, engines of various kinds, which can be transported to their respective destinations in a number of comparatively small units are assembled or erected on site, the modern large generator does not lend itself to piecemeal construction, but must perforce be built up in comparatively large and complete units, comprising stator and rotor respectively, of which the former is the more massive and unwieldly component. Quite recently special arrangements had to be made for the railway transport of a 50-ton stator from the works of an electrical manufacturing concern in the Midlands to the quayside for shipment abroad. This load constituted quite a special problem for the railway company, and has since been superseded by a still heavier and bulkier package of similar type, weighing 62 tons, and which proved beyond the capabilities of existing railway transport.

The story of the transport of this huge stator from the works of the General Electric Company at Birmingham to the power station of the St. Marylebone Borough Council by road traction, the journey occupying no less than a fortnight, has been repeatedly told in the columns of the daily Press, and points a moral in connection with the future handling of these large units. Obviously the trend of design is to bring such plant, by virtue of its bulk and weight, outside the practicable limits of both railway and road transport, and it will be necessary either to modify design accordingly, or alternatively complete the manufacturing process as far as practicable on site. Just as a modern liner is built on the slips and subsequently launched into its natural element at the riverside, so will it be necessary to build these large generating sets actually in the power stations of which they are to form the ultimate equipment. This latter alternative would appear to be the only one short of limiting the size and output of individual generating units, a practice which would not make for increased generating efficiency.

An Object Lesson.

A somewhat pessimistic but nevertheless observant correspondent writing to the *East Anglian Daily Times*, under the caption "Science in the Home," directs attention to the comparatively small number of modern scientific appliances and labour-saving devices which have found their way into the homes of the lower-middle and working classes of this country by comparison with America. In passing he suggests that part of the secret of the success of America in this connection is undoubtedly due to the high purchasing power of its workers as compared with our own. As he remarks, the name of electrical appliances is legion; the same applies to all descriptions of ingenious utensils and knick-knacks, yet the average middle and working class home is devoid of all these modern conveniences, despite the fact that a large proportion of our population gains its livelihood by manufacturing them. This correspondent cites the case of a lady visiting this country from the States, where her husband is an ordinary bricklayer, and yet she possesses a convenient residence in New York, equipped with electric light, electric cooking range, vacuum cleaner, iron, and numerous other aids to housework.

Returning to her native home in this country, she found her mother living practically under the same conditions and making use of the same obsolete utensils as had been in use for the past twenty years. Gas was still the prevailing illuminant, and there were general signs of dilapidation and the need for attention by painters and decorators. Comparing the conditions obtaining at her old home and her new, this lady very naturally expressed the opinion that she would not care to take up her residence again in the old country in the same walk of life as that which her husband's occupation opens up to her in America. Whilst admitting the truth of the comparison so candidly drawn by this observer, it is not easy to find an immediate solution. Obviously the secret lies in the discrepancy between the purchasing powers in the two countries, and, although we are making slow but steady progress in popularising the domestic uses of electricity, we are only so far bringing these advantages within reach of a very small percentage of the potential middle and working class consumers of this country.

That certain local government officials are alive to the problem above referred to is evident from the enterprise of the Barnes Corporation Electricity Department, which is wiring all the council's small house property throughout the district. In each house, in addition to electric light, a wall plug is being installed by means of which the housewife will be able to use a vacuum cleaner, electric kettle, toaster, iron, etc. The total charge for this service is the very nominal figure of threepence per week. Other electricity supply committees might well follow suit, especially in connection with new municipal housing schemes. Inculcating the electrical idea is a comparatively simple matter when such facilities exist at the outset on entering upon occupancy of a house, whereas few tenants of existing dwellings already piped for gas will face the expense and upset of wiring for domestic electric service, although fully realising the advantages to be gained. In many cases the margin between cost of living and income is too small, and they literally cannot afford to make the change.

Pulverised Fuel and Boiler Efficiency.

Those not closely in touch with modern steam-raising practice probably fail to realise what enormous strides have been made in this branch of power station practice of late years. Obviously to obtain increased overall generating efficiency we must study and improve every stage of the process from the selection and burning of the actual fuel to the delivery of the resultant "juice" at the consumers' terminals. In a recent paper before the Society of Engineers, Mr. E. Kilburn Scott, M.I.E.E., deals with the modern practice of using pulverised fuel for steam raising. The principal advantages accruing from the use of pulverised fuel are that the process permits of the consumption of low grade fuels which would otherwise be incapable of producing efficient results; smoke is abolished; there are practically no stand-by losses; there is less than one per cent. of unconsumed carbon in the resultant ash; no moving parts in the combustion chamber; boilers can be kept on load for months; exceptionally large overloads carried with ease; high overall efficiency; low labour costs; clean boiler houses; and push-button control of large boiler plants.

In effect, the use of pulverised fuel approximates to that of oil or gas firing, the furnace conditions being similar in all three cases. There is, of course, the additional cost of pulverising and grading the fuel to be offset against the above advantages, but the net gain in efficiency is well worth while, and the reduction of the labour costs probably more than offsets this factor. In treating various fuels the degree of pulverisation depends very largely on the amount of volatiles which the fuels contain, and it is necessary to specify the sieves which will allow all fuels to pass through as well as the percentage which must pass the smallest mesh sieve. The analysis and treatment of pulverised fuels is, in fact, a specialised business, calling for chemical research and the compilation of data upon which certain grades of available fuels can be suitably prepared for maximum steaming efficiency. The modern boiler house need no longer be a place to avoid as coupling dirt and smoke with the presence of sweating and labouring stokers. Under scientific conditions of steam raising it can be as unobtrusive and attractive as the power house proper, with its humming turbos and compactly arranged switchgear.

Technical Books—

I am certain that many of my readers who are already engaged in our profession, and as such aspire to the magic letters A.M.I.E.E., or who intend to take up a position in the junior ranks of the industry with hopes for advancement in the near future, will read with keenly sympathetic interest the letter from Mr. Sylvester in our correspondence columns. I receive similar complaints daily from all parts of the United Kingdom, and am only able to give the very unsatisfactory reply that the high cost rests with the British printers. Whether masters or men I prefer not to dogmatise, but the fact remains that in this country printing, like road sweeping, etc., is a sheltered industry, and as such is comparatively free from foreign competition, so the basic wages are out of all proportion to those which obtain in other industries such as engineering, hardware, lace goods, etc., which have to meet the competition of other countries in seeking world markets for their manufactures.

—And Their High Cost.

The result is that the printers—masters and men alike—are in a favoured position, which reacts harmfully on very important sections of their fellow-countrymen, and this fact was referred to forcefully a short time back in a leading article in one of the London dailies, but selfishness being one of the first laws of Nature, that is about as far as it will get for the time being, although a fair amount of English book-printing work is now going to the Continent, and judging from the specimens I have seen, more will follow, because every endeavour is being made by Dutch and other firms to meet the requirements of British publishers, and that enterprise will tell in the long run. I believe the root cause is the absurdly high wages paid in the works of the London daily and evening papers, but I cannot judge. What I do know is that the constant advances of science in all its branches render it impossible to run off large editions of books on technology, owing to the risk of changes rendering them out of date, and therefore useless, but all the same, the present cost is much more than it ought to be, even after making due allowance for the increased cost of living. Curiously enough one complainant was the son of a compositor with whom I am on terms of personal friendship, and at a second interview he told me his dad did acknowledge that my criticism wasn't really very far out. So it must go at that.

Elektron.

Meetings.—The next meeting of the Inst. of Engineering Inspection will be held at the Royal Society of Arts, John Street, Adelphi, London, W.C.2, on Wednesday, 22nd inst. at 5 p.m., when Mr. A. Hamilton will read a paper on "Crankless Engines," illustrated with lantern slides.

British Industries Fair.—The Birmingham section of the British Industries Fair, 1925, will be held in the Exhibition Buildings, at Castle Bromwich, Birmingham, from February 16 to 27, and readers who wish to obtain full information should write to the manager at the Chamber of Commerce, 95, New Street, Birmingham.

New circulars received from the **B. T. H. Co., Ltd.**, Mazda House, 77, Upper Thames Street, E.C.4, deal respectively with shop window illumination and the Tungar battery charging rectifier, for which there should be a steadily increasing demand. The Mazda blotter is also to hand, and is an attractive advert. which will help the sale of the company's well-known lamps.

Practical Electrical Engineering Hints.

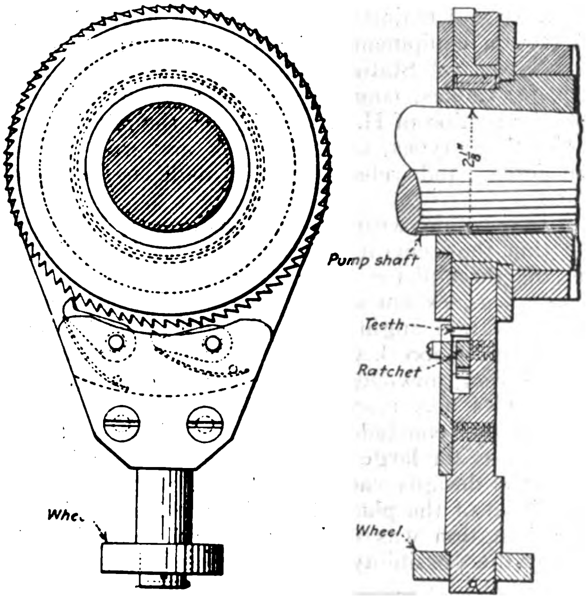
We cordially invite all our readers to contribute to this interesting and useful feature. All hints received will be given careful consideration and will be paid for at our usual rates.—The Editor.

No. 15.—How Maintenance Costs on Pumps can be Reduced.

A great reduction in the cost of maintaining reciprocating plunger pumps has been recently made in our works by the use of a device for rotating the rods and plungers.

The plungers of outside packed pumps often wear unevenly, and deep grooves are worn on them. When this occurs, it is difficult to keep the packing tight enough to prevent leakage. The wear upon the packing is thus very great, and the power consumed is much greater than it should be.

By rotating the pump rods and plungers the wear on them is more evenly distributed over the entire rubbing surface. The device used is a ratchet, shown in detail in the sketch. This enables the pump rods and plungers to be rotated a fraction of an inch during each stroke of the pump. The lever of the ratchet is actuated by a small wheel which runs on a camway mounted on the frame of the pump beneath the rod.—H. E. G.



No. 16.—How Handholes Assist in Pulling-in Underground Cables.

We have recently installed special handholes for the entrance of cables in our district, and the result is highly satisfactory, especially in positions where it was impossible to place the manhole openings in line with the cable ducts. I may add that the positions are where the duct runs immediately below the tramway lines, while just outside the lines, and parallel to them, runs the gas main.

Neither lines nor main could be disturbed, so that the opening to the manholes had to be outside the pipe. With an opening so far outside the direct line of the duct, it is difficult to install or remove cable. Therefore, the special handholes illustrated in the sketch were fitted.

The handholes are made in the form of a funnel, of cast-iron, with the large end opening into the manhole wall. The small end is cut at an angle so as to be flush with the street surface, and is closed with a cast-iron cover. The inside shape and size are such that a cable can easily be fed in either direction.—Henry A. Davis.

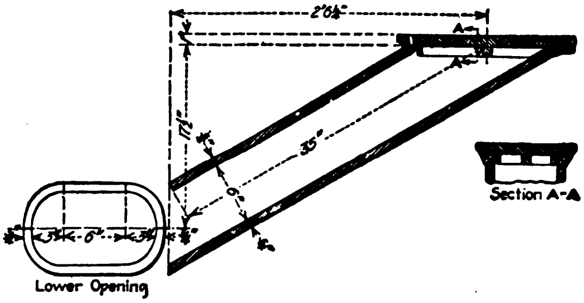


Fig. 1.—Special Handhole used for Pulling Cable.

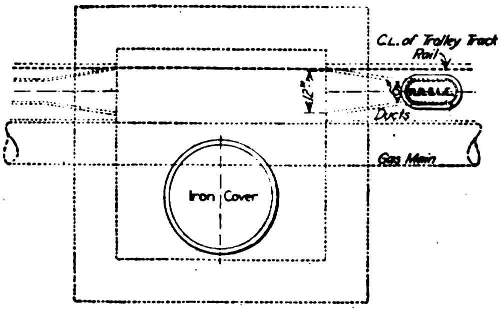


Fig. 2.—Handhole Placed in Line with Duct to Facilitate Pulling Cable.

ELECTRICITY IN MINES*

A new edition has just been issued of the "General Regulations as to the Installation and Use of Electricity in Mines under the Coal Mines Act, 1911, with Explanatory Memorandum."

This pamphlet contains the whole of the General Regulations governing the use of electricity, both below and above ground, and these are unaltered. The explanatory memorandum, however, has been revised and amplified in the light of the experience gained since the last edition in 1921; and appendices have been inserted containing (i) excerpts from the Regulations for Overhead Lines prescribed by the Electricity Commissioners; (ii) the conditions under which the Mines Department is prepared to test, as regards their safety, electric bells and relays intended for use underground in mines; and (iii) the British Engineering Standards Association definition of "flame proof enclosure." There is also a short index to the subjects dealt with in the explanatory memorandum.

---

* *Mines and Quarries*, Form No. 11, price 7d. post free from Electricity Office.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 190.

I desire to find a fault on an underground cable. Are there other tests, other than Murray's loop test, which may be applied? If so, I would appreciate practical and technical details.—"D. WILLIAMS."

(*Replies to Question No.* 190 *must be received not later than October* 25, 1924.)

ELECTRICAL INSTALLATION WORK.

BY C. SYLVESTER, A.M.I.E.E., A.M.I.Mech.E.

Solutions to the Questions in Grade I. C. &G. Examination on May 6th, 1924.

(*Continued from page* 533.)

Question 6.—What precautions are necessary in fixing a resistance?

Columns could be written round this question, since no details are given of the resistance, its value, or the capacity or voltage upon which it is proposed to use it; these factors have an important bearing upon the method used in fixing it.

Assuming the resistance to be one purchased at an electrical store, it should be wound and insulated in such a manner that, providing voltage and capacity have been specified, fixing direct upon a wall will meet the case. Here, no matter what the voltage may be, it will not be time wasted if insulating distance pieces of porcelain are placed between the resistance base and the wall; this will prevent dampness creeping from wire to frame and so prevent breakdown.

If current through the resistance is to be maintained for any length of time, it is possible that the resistance wire may become warm. Its position then should be such that nothing may come in contact with it that is likely to cause a fire; here a perforated metal cover should meet the case.

Protection against any person getting a shock is very important. If the resistance is placed in a high position on the wall that is out of ordinary reach, the case should be met. In this direction, however, where a person is likely to mount ladders and so may inadvertently touch the resistance, it should be enclosed in a perforated metal case to allow air convection and also provide adequate protection.

The most important item is efficiently to earth the resistance frame to comply with Home Office Regulations.

(*To be continued.*)

THE DESIGN OF STATIC SUB-STATIONS.*

By H. THORNTON, A.M.I.E.E.

On Friday, October 10, Mr. H. Thornton, A.M.I.E.E., read a paper on "The Design of Static Sub-stations, with some Notes on their Equipment."

After mentioning the main requirements of a sub-station building, such as would ensure a maximum reliability of supply, a minimum capital cost consistent with other considerations, and minimum operating and maintenance costs, the paper dealt with sub-station equipment under four headings: (1) H.T. Switchgear, (2) Static Transformers, (3) L.T. Switchgear, (4) Cables, connections and auxiliary apparatus.

In the section of H.T. switchgear, the relative merits of the three types, cubical, truck and ironclad, were considered, and reference was made to out-of-door types.

In connection with static transformers, the author said that the general practice had developed into the use of three-phase units for sizes up to about 1,200 k.v.a., except where the conditions of access to the sub-station might be particularly difficult, but for sizes over 1,200 k.v.a., a three-phase transformer became very unwieldy, and the use of three single-phase units was more general.

The paper concluded with descriptions of types of sub-stations for large and small industrial and lighting loads, the designs varying not only with the size and disposition of the plant, but with the locality in which the sub-station was to be built, and being influenced also by the possibility of future development.

Tenders Accepted.—The Siemens and English Electric Lamp Co., Ltd., have obtained a contract for the supply of Siemens vacuum and gasfilled lamps to the education authority of Glasgow.

Removal.—The Walker Electrical Service state that owing to the rapid expansion of their business they have taken over more extensive premises at Annandale St. (opposite Industrial Hall), Edinburgh.

The Henley Wiring System.—Readers interested in wiring should make a point of writing the Henley Company for a copy of their new brochure, D 257, on "Modern Electric Wiring," as advertised on the front cover of this issue.

Quotations Wanted.—The Municipality of Bloemfontein are calling for tenders for the supply and erection of boiler-house equipment. Also for the supply and erection of piping, pumps, etc., for the Council's new electric power station. Specifications, etc., from the D.O.T. (Room 52), 35, Old Queen Street, London, S.W.1.

Meetings.—The Junior Inst. of Engineers will meet on Friday, the 17th inst., at the Royal Society of Arts, John Street, Adelphi, at 7.30 p.m. Lecture, "High-voltage Electric Oscillations," by K. P. Howgrave-Graham, M.I.E.E. (of the Northampton Polytechnic Institute). Also on Friday, the 24th inst., lecturette, "Powdered Fuel," by F. F. Evans (Member), and on Friday, the 31st inst., lecturette, "Audio-frequency Transformers," by H. J. N. Riddle (Associate Member). Both at 39, Victoria St., at 7.30 p.m.

---

* Abstract of paper read before the Junior Inst. of Engineers.

A HUNDRED YEARS OF ELECTRICAL ENGINEERING.*

(Continued from page 555.)

As in all other types of machinery, the output obtainable from a given size has been gradually increased by improvements in the electrical, magnetic, and mechanical properties of the materials employed, and by improving the design so as to remove ever further the limits imposed by heating, sparking, voltage drop, etc. The freedom from trouble of the enormous number of electric trams and trains, to take only one class, is a testimonial to the reliability of the modern direct-current motor.

The alternator has had a more varied development than the dynamo, mainly because of the absence of the commutator. The necessity of keeping the brush gear stationary and accessible, and therefore allowing the commutator and armature to rotate, led to an early standardisation of type in the D.C. machine. In the alternator there was no such limitation, and whether the field system should be inside or outside the armature and which of the two should rotate were largely matters of choice. There are great advantages in having the armature, which usually carries a high-voltage winding, stationary, and the usual practice has been for the field system to rotate within the armature. The most striking and best-known exception is the umbrella type of alternator installed in the first Niagara power station, in which the field system rotates outside the armature. The design of alternators has been controlled to a large extent by the development of the prime mover. On the Continent of Europe the slow-speed horizontal steam engine led to the construction of alternators of enormous diameter in order to get the necessary peripheral speed, the axial length being consequently reduced to a few inches. In several cases these machines reached such a height that the travelling cranes in the erecting shops were useless, and special tackle had to be erected in order to assemble the machines. In England the high-speed marine-type engine was generally preferred, and consequently the alternators had a smaller number of poles and a smaller diameter. All this has now been modified by the development of the steam turbine.

Ferranti was apparently the first to suggest that the power station should be outside the city, at a point convenient for fuel and water supply, and that the power should be transmitted into the city by high-voltage alternating currents. In 1890 he built the Deptford Station for the London Electric Supply Company, and installed 1,000-kilowatt 10,000-volt alternators. This was the pioneer high-voltage underground cable transmission, and much was learnt concerning the peculiarities of alternating currents when transmitted over cables of considerable capacity. The following year, 1891, saw the first long-distance transmission by means of overhead conductors in connection with the electrical exhibition at Frankfort-on-Main; three-phase power was transmitted, at 8,500 volts, from a water-power station at Lauffen to Frankfort, a distance of 110 miles.

This development of the use of high-voltage alternating currents followed the development of the transformer. Gaulard and Gibbs patented a system of distribution involving transformers in 1882, and, although their patent was upset in 1888 on the ground of its impracticability, the present method of using transformers for the distribution of electrical power was introduced in 1885, and shown at the Inventions Exhibition in London in that year. Although from 1890 onwards there has been a steady increase in the size of alternators and transformers and in the voltage employed for long-distance transmission, the last few years have seen a really amazing increase in the size of the units employed. In 1913 the largest two-pole turbo-alternators had an output of 3,000 revs. per minute of about 7,500 kilowatts; such machines are now made up to 30,000 kilowatts, and four-pole alternators are running at 1,500 revolutions per minute, with an output of 60,000 kilowatts. This increase in size and in peripheral speed has been made possible by improvements, both in the material and in the design. With a bursting speed 25 per cent. above the running speed, the peripheral speed can now be raised to 150 metres per second. Improved methods of cooling and a better understanding of the various causes of loss in the armature have enabled the materials to be used at higher current and flux densities.

This great increase in the size of units is not confined to the steam turbo-generator, as can be seen from the water-turbine sets recently added to the Niagara installation. Whereas the original Niagara turbines were of about 5,000 horse-power, the new ones have an output of 70,000 horse-power at the low speed of 107 revolutions per minute.

The importance of cheap electric power has led to this great increase in the size of the units in the generating stations. Any slight difference of efficiency between a 10,000-kw. and a 60,000-kw. alternator is of little importance, and would certainly not counterbalance the decreased factor of safety due to concentrating the whole power supply in three or four large units, instead of distributing it between a dozen or more units. The reason for the adoption of the smaller number of large units lies almost entirely in the decreased capital cost per kilowatt of plant. In my opinion, however, there are many cases in which too much consideration has been given to this factor, and too little to the importance of a guaranteed continuity of supply.

Of even greater interest than the growth in the size of the units in the power station is the development of the switch control and protective gear, which is such an essential element in the success of the modern power plant. In the early days of electrical supply all the switchgear was mounted on slate panels in the engine-room; then, as the power and voltage increased, the switches were placed above, below, or behind the board and operated by mechanical links; then they were removed to another part of the building, each enclosed in its own fireproof cubicle, and operated by means of relays. The modern high-power switch, like the transformer, is oil-immersed in its iron containing case, and is so robust and weatherproof that it needs no further protective covering, but it can be placed in the open air. The insulated bushings through which the leads are taken into the case are the most vulnerable points, but constitute no insuperable difficulty at the present time.

---

* Address before the British Association, at Toronto, by Professor G. W. O. Howe, D.Sc., President of Section G.—Engineering.

The development of these robust and weatherproof switches and transformers has led to the introduction of the open-air sub-station in cases where alternating current has to be transformed from one voltage to the other, and there is consequently no running machinery. In generating stations also much of the controlling and transforming plant which was formerly housed in the building can now be placed outside, with considerable saving on the cost of the building.

In connection with the conversion of alternating to direct current, mention should be made of the mercury arc rectifier. Great improvements have been made in recent years, especially in Switzerland, and a number of high-power arcs have been installed in sub-stations. Although they have the advantage of doing away with running machinery, the modern rotary converter is such a reliable piece of apparatus that it is very questionable whether it will be replaced to any considerable extent by the mercury arc rectifier.

Until recently, the only means of producing a large amount of high-voltage D.C. power was by connecting a large number of carefully insulated dynamos in series, as in the well-known Thury system of power transmission. Within the last two or three years another method has been developed, viz., the so-called transverter, which consists of an arrangement of transformers and a system of rotating brushes, whereby a three-phase A.C. supply is converted into an almost steady continuous current. The first apparatus of this type to be exhibited is installed at the British Empire Exhibition at Wembley, and is designed to deliver continuous current at 100,000 volts. It can also be used for the reverse process. It would thus enable a three-phase generating station and a three-phase sub-station to be connected by a direct-current transmission line, thus avoiding not only the maximum voltage of 1.4 times the effective voltage, which was one of Lord Kelvin's objections to the A.C. system, but also all trouble due to the capacity and inductance of the line. Whether the disadvantages of the transverter, when it is fully developed—it is yet in its infancy—will more than outweigh these advantages remains to be seen, but, apart from the transmission of power, the device may have many applications.

Electric traction represents one of the most important branches of electrical engineering. It shares with the petrol motor the distinction of having absolutely revolutionised the methods of transport within a single generation. In its origins it is nearly a century old, for attempts were made in the 'thirties to apply Faraday's newly discovered principle to the propulsion of vehicles, but, with very primitive motors and primary batteries, these attempts were doomed to failure. The development of the dynamo and motor in the 'seventies opened the way to further experiments, and at the Berlin Exhibition in 1879 a line one-third of a mile long was shown in operation, a locomotive drawing three cars. The first regular line was opened to traffic near Berlin in 1881; it worked at 100 volts and the current was collected from an insulated rail. Toronto was the scene of one of the earliest experiments in America; C. J. van Depoele, after some experiments at Chicago in 1882 and 1883, ran an electric locomotive in 1884 between the street-car system and the Exhibition in Toronto.

(*To be continued.*)

A RECORD TRANSPORT FEAT.

In spite of all the discussion there has been upon the need for improved transport in this country, it is somewhat alarming to find how ill-equipped we as a community are to cope with the movements of really heavy loads from one place to another. The problem has just arisen in very acute form due to the great advances made in the electrical industry, necessitating units of generating plant whose main frames when built up weigh well over 50 tons. Not long ago we were able to describe how the L.M.S. Railway carried the 50-ton stator of an electrical generator built by the General Electric Co. Ltd., from Birmingham to Manchester for shipment to Australia. This was undoubtedly a creditable achievement, but still more recently the General Electric Co., Ltd., had to arrange to move a similar piece of apparatus weighing 62 tons from Birmingham to the generating station of the St. Marylebone Corporation; this second generator is capable of some 25,000 h.p.

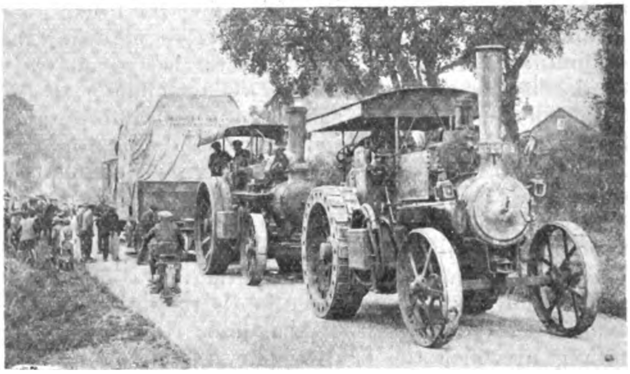


FIG. 1.—THE CAVALCADE UNDER WAY.

The General Electric Co. approached H. Bentley and Co., Ltd., haulage contractors, of Bradford, who undertook to tackle the job. Without going into detail, we would state that the stator, which is 12 ft. square and 11 ft. 2 in. high, was accommodated on a truck with two specially designed 4-wheel swivel bogies, so arranged that the wheel track was 2 ft. wide

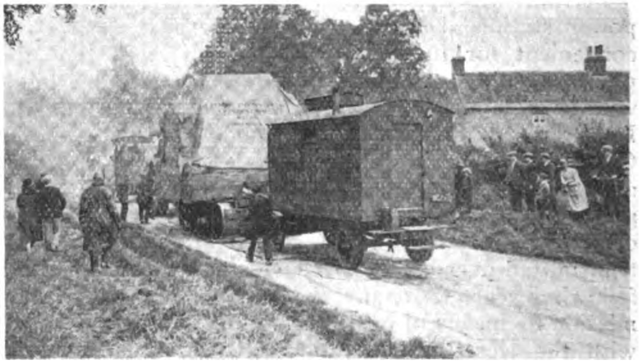


FIG. 2.—PROGRESS—TWO MILES PER HOUR.

on each side of the bogey. The load of stator and truck was thus 75 tons. Two traction engines were normally employed for hauling purposes, while a third engine which usually had to haul the coal truck was available for steep gradients. In addition, this cavalcade was supplemented by the travelling caravan, wherein the engineers and others responsible for the transport of the load had to live. The selection of a route was no easy matter; in one case a bridge over the road did not allow sufficient headroom (15 ft. was required).

From what we have said and from the magnitude of the task in general, no surprise will be felt that the time elapsing from the stator leaving the G.E.C. Witton Works until its delivery at the St. Marylebone Generating station was 10 days. Great is the credit due to the General Electric Co., Ltd., and Messrs. H. Bentley for the triumph achieved in the face of great difficulties.

ELECTRIC MOTORS.*

By W. N. Y. King, A.C.G.I., A.M.I.E.E.

A brief historical survey showed the development of the electric motor from 1831, when Faraday announced his discovery of the principle of magneto-electric attraction, to the modern forms of to-day. The great changes which took place resulted in improvement in efficiency (about 90 per cent. to-day) and in magnitude, but the materials used are much the same throughout, *i.e.*, copper for the current conducting portions, and iron and steel for the magnetic field.

The specialisation of motors was then dealt with for such purposes as steering gear for ships, deck winches, fan motors for boiler, draught and ventilation, cranes and hoists, woodworking machines and printing machines.

The different characteristics of motors required for these purposes were pointed out, *e.g.*, hoists and cranes required series wound motors to obtain large starting torque, and the dynamic brake system for controlling lowering was described. Woodworking machines are suitably driven by shunt or light compound wound motors. Printing machines, owing to requiring speed ranges very widely different, must be driven by a motor or two motors, each with special control systems adapted to suit. Three systems devised for this class of work were briefly described :—

(1) Two-motor system.
(2) Motor generator system.
(3) Single-motor system.

The Laurence-Scott direct current single-motor system was described in some detail. Developments in the future were considered as regards improvement in efficiency by reduction of heat loss, also simplification of variable speed A.C. motor operation, and greatly increased application of electricity for all purposes.

The lecture was illustrated by a number of lantern slides.

Removal.—On October 8 the Radio Press, Ltd., removed to Bush House, Strand, London, W.C.2. Telephone No.: City 9911 (5 lines). Telegraphic Address: Radbooks, Estrand, London.

---

* Résumé of lecture before the Birmingham Electric Club, September 26, 1924.

Reviews of Books, &c.

[Books noticed in this column will be sent from ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

COAL AND OIL-FIRED BOILERS. By Eng.-Cmdr. F. J. Drover, R.N. Demy 8vo, cloth, 350 pp., 191 illustrations. (Chapman and Hall, Ltd., 16s. net.)—The recent heavy increases in the cost of fuel for steam raising, whether coal or oil, has had a direct result in driving engineers to keen consideration of the problems associated with boiler-house economy, and the author has performed a timely service in producing a book which is certain to appeal to every central station engineer who wishes to study the details of the latest types of boilers now on the market and to find out which of them is most likely to suit best the problems with which he will be faced when making the next extensions to his plant or preparing the plans for a new station to take the place of one which is getting out of date. Space does not permit us to give a lengthy criticism, but we can say at once that Engineer-Commander Drover has been most careful in so wording his text as to impart a clear and complete understanding of the construction of the different types of boilers which are suitable for the high steam pressures now in vogue, as well as of their maintenance and operation. The five sections into which the book is divided deal respectively with "Combustion and Feeding," "Types of Boilers," "Management and Upkeep," "Oil Fuel Burning" and "Materials, Design and Construction." Each section is freely illustrated with first-class diagrams and there are numerous folding plates from drawings which would otherwise lose their value if over reduced. Altogether the book is one which it has been a pleasure to read, and we can cordially recommend it to all boiler-house engineers, as well as to any students who are taking up "steam" in the approaching winter session at the technical institutes.

Electric Vehicles.—Readers who are interested in this ever-growing branch of the electrical industry should make a point of reading "The Electric Vehicle Handbook," by Cushing, price 10s. 6d. net, post free from S. Rentell & Co., Ltd., of 36, Maiden Lane, London, W.C.2. It contains much valuable information on the subject.

Belfast Broadcasting Station.—The Belfast branch of the British Broadcasting Station will be formally opened on the 24th inst. by his Grace the Duke of Abercorn, Governor of Northern Ireland. The broadcasting which has been going on for the last couple of weeks is, it is intimated. of a purely experimental nature.

Book Amalgamation.—Laxton's Builders' Price Book—now in its 132nd annual edition—and Lockwood's Builders' Price Book—now in its 60th annual edition—are to be amalgamated to form one comprehenisve Builders' Price Book under the title of "Laxton's and Lockwood's Builders' Price Book." under the management of Kelly's Directories, Ltd., and in future copies will be available either from Kelly's Directories, Ltd., or from Crosby Lockwood & Son.

Faraday House O.S.A.—The sixteenth annual dinner of the Faraday House Old Students' Association will be held at the Hotel Cecil on Friday, October 31. Mr. R. N. Vyvyan, M.I.E.E., will be in the chair, and there is sure to be a large attendance. Members may introduce guests, who need not necessarily be Faradians. A musical entertainment will, as usual, follow the dinner. Early application for tickets should be made to the Hon. Sec., H. W. Fairman, Faraday House, Southampton Row, London, W.C.1.

Various Items.

Meetings.—The Inst. of Welding Engineers will meet in the Engineers' Club, Coventry St., London, W.1, on Thursday, the 23rd inst., at 8 p.m. Paper, "Steel Wire: its Manufacture, Properties and Uses for Welding and Other Purposes," by E. A. Atkins, M.I.Mech.E., M.I.W.E.——The I.E.E. will meet at the Institution, Savoy Place, Victoria Embankment, W.C.2, on Thursday, the 23rd inst., at 6 p.m., when the inaugural address will be delivered by Mr. W. B. Woodhouse, President.

X-ray Apparatus Wanted.—A firm of dealers in scientific instruments and electro-medical apparatus in Novi Sad, Jugo Slavia, are desirous of receiving catalogues and prices of X-ray apparatus from British manufacturers. The name can be obtained by suppliers of such apparatus of U.K. manufacture upon application to the D.O.T., 35, Old Queen St., London, S.W.1.

The Tyranny of the Czars.—At the general quarterly meeting of the Co-operative Wholesale Society on Saturday, at Manchester, the question of compelling all employees to be members of trade unions was decided by a majority of 164 for compulsion. The directors' recommendation that heads of departments and managers of works be exempted was defeated by thirty-one votes. Employees of any class must now join a trade union or be dismissed.

New Books.—An interesting catalogue of books to be published during the autumn by Messrs. Chapman and Hall, Ltd., has been issued by them from their office at 11, Henrietta St., London, W.C.2. It contains several pages of announcements regarding the new editions or entirely new works of a scientific and technical nature which they are now preparing for the trade, and as several of these are of direct electrical and engineering interest we should most strongly recommend readers to apply for copies of the catalogue without delay.

Another Wireless Exhibition.—The proprietors of the *Nottingham Guardian* are arranging to hold a Radio, Wireless and Electrical Exhibition at the Empress Rink, King Edward Street, Nottingham, from Monday, November 3, to Saturday, November 8, inclusive, and full particulars may be obtained from the organising director, Mr. G. P. Stephens, at 2, Park Row, Nottingham In view of the fact that the B.B.C. have recently installed a relay station in Nottingham, which aroused considerable local interest, the exhibition appears to have every prospect of success.

The Junior Institution of Engineers.—The October issue of the *Journal of the Junior Institution of Engineers* contains a full reprint of a paper on "Some Considerations in Power-station Design," which was read at Birmingham on November 27, 1923, by Mr. F. W. Lawton, A.M.I.Mech.E., as well as the annual report of the Council and a list of the papers which were presented and discussed during the year. This Institution is making good, steady progress throughout all parts of Great Britain, as well as in the Colonies, and it is a pleasure to note the enterprise with which its affairs are managed. They reflect much credit on the Secretary, Mr. H. G. Riddle.

Congratulations.—We extend our most sincere congratulations and compliments to Messrs. Longmans, Green and Co. on the completion of two centuries of continued activity right away from the reign of George I., and also on the magnificent catalogue which they have just issued. A very large number of the readers of this paper are well acquainted with the name of Messrs. Longmans through the purchase of electrical books which have been published by them and for which they hold such a high reputation, and we have no reason to doubt that under the present skilful management, combined with the cordial support of a first-class staff, the firm will continue in its prosperous career for centuries yet to come.

An Interesting Chinese Lighting Installation.—The new premises of the Hong Kong and Shanghai Bank, which occupy a prominent position on the Shanghai Bund, form a very imposing building, the erection of which occupied three years, the work being carried out by Messrs. Trollope and Colls, of London. It has its own private electric generating plant, which consists of a crude-oil engine direct coupled to G.E.C. "Witton" 220-volt generators. The lighting and power switchboards, in addition to the main house distribution boards, are all of G.E.C. manufacture, while for the lighting large quantities of Osram vacuum and gasfilled lamps are in use, as well as white Osrams for counter lighting, for which they have been found particularly suitable.

Trade Notes.

A pamphlet giving details of "Berrite" joint boxes and sealing compound has been issued by **Messrs. Berrite, Ltd.**, of Hayes Road, Hayes, Middlesex, and will appeal to all readers who are in any way associated with high voltage installation work. The makers wish particularly to draw attention to the fact that they quote the real sustained electric strength as distinguished from the fantastically high figures frequently given, which are obtained by quickly raised voltage tests and bear but little relation to the real electric strength. The compound can be made with a specially high melting-point for use in tropical climates, or conditions where a high temperature prevails.

Three new radio pamphlets to hand from the **B.T.-H. Co., Ltd.**, deal respectively with their Radiola Crystal Receivers, Radiola No. 1 and the Radiola Portable Receivers. They should, therefore, appeal to all factors and dealers in wireless goods generally, to whom copies will willingly be sent on receipt of proper trade application. We have also received circulars, Radiola 2 and Radio Valve Type B.6, both of which will appeal to dealers in wireless supplies.

Booklet No. 11 is the title of a new pamphlet just issued by the **Cambridge Instrument Co., Ltd.**, of 45, Grosvenor Place, London, S.W.1. It contains 68 pages of illustrations and details regarding Cambridge engineering instruments, such as electrical CO_2 apparatus, microscope lathe-attachments, recording meters, thermopiles, etc., and will therefore appeal to a very wide circle of engineers, testing experts and others, who should write for it forthwith.

A useful list of standard commutators for car-lighting dynamos has been issued by the **Auto-Car Electrical Equipment Co.**, of Mitchell St., London, E.C.1. The list covers the ground in a very comprehensive manner, and should therefore be of direct interest to every country electrical engineer and garage owner, as well as to contractors generally, to whom it will be willingly sent on application.

The October price list of the **Siemens and English Electric Lamp Co., Ltd.**, has been issued by them from the office and showrooms at 38, Upper Thames St., London, E.C.4, and the various electrical sundries which are illustrated and priced thereon are certain to be of direct interest to all contractors and retailers, to whom the list will be willingly sent on application.

From **Condrup, Ltd.**, of 78, Fore St., London, E.C.2, we have received a circular describing the new types of Primus lamps which they are now placing on the market, including the special Primus blow lamp and furnaces for melting metal, heating soldering irons, etc. These will, of course, appeal to all electrical contractors, and we recommend application for the list.

Sample Pair Sent on Approval for 8/6.
Made of Pure Para Rubber, soft and durable and unaffected by climatic conditions
DAVID MOSELEY & SONS, Limited,
ARDWICK, MANCHESTER.
MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
A PRACTICAL TRADE JOURNAL

OCTOBER 24, 1924.

CONTENTS. PAGE

What's Wrong with Our Telegraphs? 571
Illuminated Signs 572
The "Record" at Wembley 572
Our Wireless Corner 573
National Association of Supervising Electricians—Presidential Address 574
Current Topics 577
Electrical Engineering—Grade I. 578
Electric Passenger Lifts 579
Questions and Answers by Practical Men 581
A Hundred Years of Electrical Engineering 582
Various Items 583

WHAT'S WRONG WITH OUR TELEGRAPHS?*

By an Old Telegraph Man.

From time to time we read complaints about the delay in the receipt of telegrams. Sometimes a telegram announcing an arrival reaches its destination after the traveller has reached home. Occasionally serious financial loss occurs owing to delayed telegrams, and in most cases definite inconvenience occurs. The average man lays all this at the door of the "Government," and proceeds to glorify private enterprise at the expense of State Socialism. And he is not so far wrong, since the failure of the telegraphs is a failure in administration.

Twenty years ago the British telegraphs were a pattern for the whole world to admire, and their excellence was universally admitted. To-day the apparatus designs are equally admirable. There is a large staff of men of good ability, and yet the results are wretched. To understand the situation one must go back to the days when telegraphs first entered the field of practical business. In those days there were no motor-cars, trains were relatively slow and infrequent, and the era of electric tramways, railway and motor 'buses had not arrived. Consequently, the time taken to transmit and to deliver a telegram was very much less than the actual physical carriage of a message by any other means. Over very short distances, even then special conveyance could compete in rapidity with the telegraphs. But, as time has gone on, the means of communication have grown more and more rapid, frequent, and easy, with the result that the telegraph has suffered in comparison. Added to this there is the enormous volume of business now conducted by telephone. All these factors have led to serious diminution in telegraph business and a serious loss on the year's working—a loss which we can ill afford in these days of crushing taxation.

Telephone men generally say that there is no place for inland telegraphs, and that their place will be, and is being, taken by telephones, and that the sooner the telegraphs are dead and buried the better. But this is quite unsound, because, given a rapid and accurate service, there exists a vast field for development. The spoken word will never supersede entirely the written communication, and there are countless instances where written messages are essential. To give a single instance, betting messages are largely sent by this means, and the cynic contrasts the public prosecution of a club which wants money for a new billiard table with the facilities provided at race meetings by the State. Still, it needs no argument to show that a rapid, cheap and efficient telegraph system is a national necessity. Given this, and admittedly we have not got it, a large volume of business which is dealt with by post or is settled over the telephone subject to written confirmation would fall to the lot of the telegraphs. The speeding up which would result certainly has a monetary value which would well justify the difference in cost between the ordinary post and the telegraphs. Whilst speaking of this larger field, it must be remembered that the day when everyone has a telephone and a motor-car is afar off, consequently urgent private messages of distress must always be delivered by hand to the recipient. In this field the telegraphs have proved their value, and have brought every village within range.

The telephone is relatively a costly means of communication over long distances, since the speakers have exclusive use of the two wires of a circuit during conversation, whereas eight, ten or twelve telegraph messages may be transmitted over a single wire simultaneously or, as is frequently done in America, the telegraph messages may be sent along a telephone circuit without interfering with its use for telephone conversations. Hence it will be appreciated that the telegraphs are, or should be, the cheap democratic means of communication over distances of more than a few miles.

Something has been done in dividing the kingdom into zones linked together by highly efficient and rapid telegraphs, but the essential difficulty remains that, where a message has to undergo several transmissions in transit, the delay and cost are excessive. Retransmission is involved when the place at which the message originates has no line to the place at which the message is delivered. This problem may, perhaps, be solved by a system of switching comparable with that used in the case of telephone trunk lines. There are difficulties in the way of adopting this proposal, but they are by no means insuperable. It can be said that very much greater expenditure on plant is well justified when labour savings can be shown to result, and the policy of starving the telegraphs is one which will result in a thoroughly discredited service and an increasing loss for the taxpayers to bear.

When the difficulties in securing a rapid point-to-point transmission of messages have been solved, there still remains the problem of securing quick delivery of the messages. Where the recipient has a telephone, the message can be dictated to him from the telegraph office without delay. In other cases, delivery by motor cycles along pre-determined routes at half-hourly intervals naturally occurs to one. It is not much use arranging for a message from London to Edinburgh to be received there within ten minutes of the time it was handed in if an hour or more is occupied in delivering it at its destination by hand.

---

* This article is founded on a paper read before the Institution of P.O. Electrical Engineers on "The Problem of the Telegraphs," by T. E. Herbert.

This article has been written in the hope that the attention drawn to the problem will result in energetic measures being taken to solve the problems involved, and to restore the British telegraphs to the proud position which they once occupied.

ILLUMINATED SIGNS.

For some years it has been the practice for newspapers to seek publicity outside their own pages and contents bills. Next to posters the most favoured medium for this extraneous publicity is the illuminated sign. The reason is evident. The appeal of a national newspaper, or even a local one for that matter, is, within its area of circulation, absolutely unlimited, and is not subject to the age, wealth, or social position of its potential readers. Everybody, in fact, is a potential reader of any newspaper circulating in or near his place of habitation or business.

Signs and posters are therefore ideal media for newspaper publicity, because they, like the paper themselves, are quite undiscriminating in their appeal.

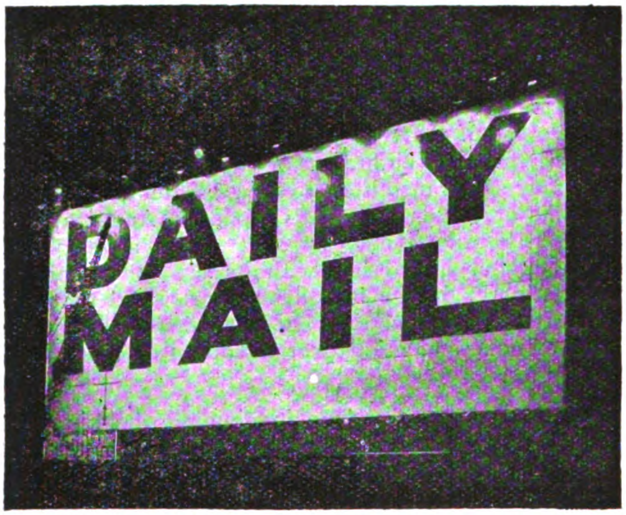


FIG. 1.—"DAILY MAIL" SIGN AT BLACKFRIARS BRIDGE.
(Lighted by means of B.T.-H. "Posterlite" units and Mazda gasfilled lamps.)

The *Daily Mail* has made considerable and highly effective use of both signs and posters. Everyone has seen the large painted advertisements bearing the name of this paper scattered about London and the provinces. Of these, many are illuminated, and one of the most conspicuous is situated by Blackfriars Bridge. It measures 110 ft. in length by 50 ft. in height, which is certainly a remarkable size, but the lighting (done from the top) is still more remarkable.

The high and uniform intensity of the illumination is effected by sixteen B.T.-H. "Posterlite" units, ten of them being fitted each with two 250-watt, and six of them each with two 400-watt Mazda gasfilled projector lamps. The smaller units are attached to the top of the board by means of 4 ft. brackets, and the larger by means of 8 ft. brackets.

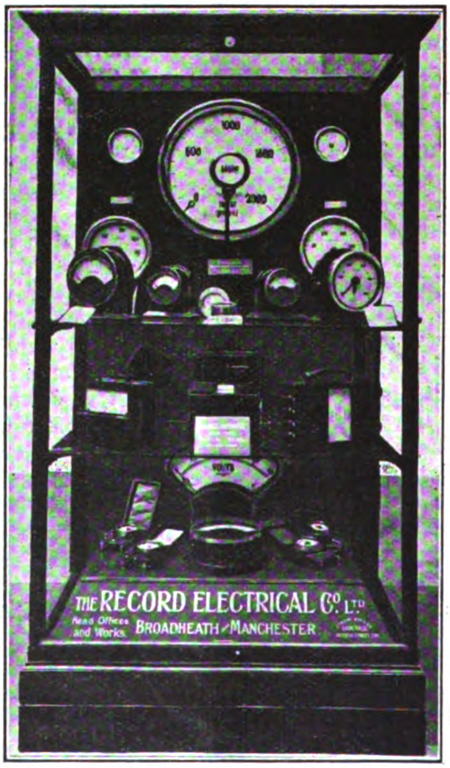
The "Posterlite" unit was, as its name implies, specially designed for the illumination of hoardings by means of an ingenious arrangement of reflector and louvres which projects a flat and almost parallel beam of light, and the makers claim that it is the only lighting unit on the market which has successfully solved the problem of illuminating vertical surfaces from the top when such surfaces exceed a few feet in depth.

Another newspaper sign of conspicuous merit is the *Daily News* sign in Piccadilly. This is a trough letter sign, and the distinctiveness is due largely to the use of Mazda colour-sprayed gasfilled lamps, of which 1,059 are employed, viz., 732 30-watt lamps and 327 20-watt lamps. More than half the lamps are yellow, about one-third are red, and the remainder are green. The sign itself is 20 ft. high and 16 ft. 6 in. wide.

The two signs here described have nothing in common excepting that they are both illuminated and are both extraordinarily effective in their different ways. Each sign is, of its kind, perhaps the finest in the country, and the proprietors of the papers, the Boro' Billposting Co. (who own the sites) and the British Thomson-Houston Co., Ltd. (who supplied the lamps and lighting equipment), are to be congratulated upon the success which has attended their enterprise.

THE "RECORD" AT WEMBLEY.

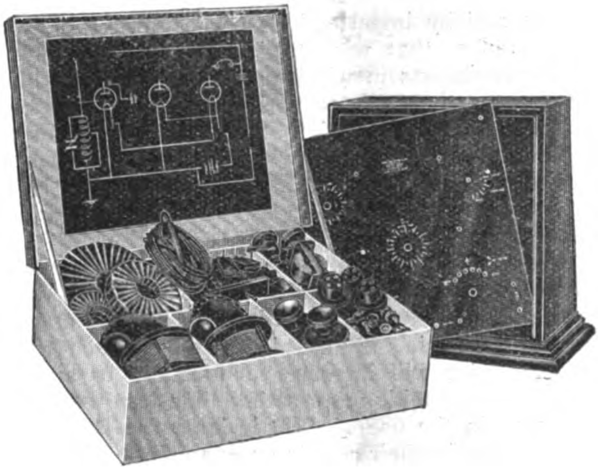
An innovation is to be found in the exhibit of the Record Electrical Company, Ltd., electrical instrument makers, London and Broadheath, near Manchester, in Avenue 14, Bay 8, in the shape of an A.C. switchboard instrument of the circscale type, on a moving iron principle, giving a deflection of 330 degrees. The instrument is a suitable counterpart of the well-known permanent magnet circscale. The accuracy is within B.E.S.A. first-grade limits, and temperature and fre-



quency errors are negligible. The "1924" model of the Record ohmmeter and generator is also worthy of mention, being under 6 lb. in weight, and numerous improvements are incorporated in this model. A complete range of the moving coil circscale instruments, having dial diameters from 2¾ in. to 16 in are shown. Examples of portable testing apparatus, circuit breakers, and automatic battery switches and the usual type of sector scale instruments, in which the scale length is equal to the dial diameter, are also exhibited.

Our Wireless Corner.

For the benefit and interest of our many readers who are interested in Radio reception and the apparatus connected therewith, we are setting apart certain space in our columns dealing with matters of interest or details of apparatus which call for special notice from time to time, and which we think may be helpful. At the moment we have before us some particulars of material in sets for the home construction of wireless reception cabinets which we think may be of some advantage to our readers to notice. It is, of course, possible to procure details of every description almost anywhere, and with them to set up some form of construction more or less satisfactory; but in the selected sets of parts for home construction now under notice there are many features which render them exceptional, and which are calculated to lead to greater satisfaction and more certain successful results on the part of an amateur. The makers of these sets have had long and expensively acquired experience through continued and costly experiment in designing and manufacturing the finished articles, which, in their various patterns and capacities, are in use in many thousands of homes in all parts of the country; and, in offering the complete sets of parts for home construction by the amateur, they are able to be guided by such experience to select only those details which, when put together, will more certainly give the best result, and be fitted to produce the most efficient output by reason of their known and tested suitability from the points of view of correct balance and perfected relationship with each other, as well as by their marked superiority through constructional excellence and precision.



A striking feature, also, of these sets is the method of packing. Instead of the parts being thrown together in a heterogeneous jumble in a box or parcel, they are supplied in a neat, strong case (as illustrated), divided into several compartments, amongst which the several details are distributed and may be selected or handled without confusion. This is especially of advantage also to the retailer, who is able to display in a much more attractive manner to his customers, and also to maintain his stock in much more orderly condition. The box itself makes a very useful adjunct in the amateur workshop after its contents have been dealt with. Sets of parts are supplied to suit any requirement of amateur construction, and all the parts necessary are sent out prepared for fitting together—panels being drilled and tapped, and the chart plainly marked for assembly—so that failure or mistake is almost impossible. The engraving gives a good idea of one of such sets as now supplied, and they may be obtained from the simplest crystal instrument to one involving the use of three or more valves. The makers are Messrs. Rogers, Foster and Howell, Ltd., of Edward Road, Balsall Heath, Birmingham, from whom full particulars of their varied manufactures may be obtained.

MULLARD SAFETY DISCS.

Another item of great utility to valve users may also be noted in the safety disc introduced and supplied by the Mullard Valve Co., Ltd., many thousands of which were given away by that firm at the recent exhibition at the Albert Hall. It has been the unfortunate experience of many users of valves to lose their valves through the filament pins coming in contact with the sockets connected with the H.T. battery when inserting or changing valves without switching off. This trouble is entirely eliminated when a safety disc of the type we are noticing is affixed to the valve holder. It is merely a disc of coloured insulating, felt-like material having an adhesive backing by which it may be affixed to any ordinary valve holder. It has four holes which register with the sockets, and until the pins have passed through these holes no contact is made. It is obvious that, unless the valve pins are in their correct position, they cannot pass, hence accidental contact with the wrong voltage terminals is practically impossible. It is an exceedingly simple device, and quite efficacious.

WIRELESS BEACONS.

The first experimental wireless beacon to be erected on the coast of Great Britain has been installed by the Marconi International Marine Communication Co., with the permission of Trinity House, at Nash Point, between Swansea and Cardiff, and has been subjected to severe practical tests over a period of six months with most satisfactory results.

It consists of a Marconi ¼ kw. quenched spark transmitter, which automatically transmits its own call sign, GKD, on a wave-length of 1,000 metres. It is operated by means of an Austin paraffin-petrol engine, the petrol being used for starting, and the machine automatically switching over to paraffin. The power used is sufficient to enable bearings to be obtained by means of the Marconi marine direction finder at a distance of 50 miles. The beacon, however, does not interfere with broadcast reception outside a range of three miles from Nash Point, and it has already proved very useful in the Bristol Channel, where the opportunities to make use of a direction finder are very limited, and the trials have been sufficient to show that such transmitters will be of great assistance to navigation on many other parts of the coast.

High-Voltage Electrical Oscillations.*

When electricity leaves its ordinary duties of providing power, heat and light, it can indulge in many playful exhibitions of a spectacular and wonderful character. On Friday, October 17, with Mr. R. P. Howgrave Graham as the "magician," an electric current of not much more than half a kilowatt was increased in voltage and frequency to a very high figure and made to perform many interesting tricks. Thus it lit a 100-volt lamp with three feet of aluminium shorting its terminals, and with 20,000 volts across them. Another lamp coupled with a transformer and a sheet of tinned iron was carried about with with no apparent connection to the source of supply, and yet induction was sufficiently great to light the lamp to full brilliance. Other experiments dealt with brush and spark discharges through air and through different materials such as wood, or the branch of a shrub, and also through Geisler and Crookes tubes. The different colours produced were very effective. The final experiment was simple but the result extraordinary. The lecturer rubbed a static conductor on his head, touched his watch with it and at the same moment a bell rang several feet away.

The experiments made one think that the problems of transmiting energy through the air or ether were all solved, and certainly energy can be transmitted over relatively large gaps at a not inconsiderable efficiency, but that is the present limit.

The spectacle of Mr. Howgrave Graham with a glowing halo round his head, or with sparks flying out of his finger tips, will not readily be forgotten by those who attended his demonstration.

NATIONAL ASSOCIATION OF SUPERVISING ELECTRICIANS—PRESIDENTIAL ADDRESS.

The presidential address of Mr. F. Gill, M.I.C.E., M.I.E.E., was delivered before a meeting of the National Association of Supervising Electricians, on Tuesday, October 14, 1924.

Mr. Gill prefaced his address by expounding the economic principles underlying wealth, capital and money. Wealth is the result of labour applied to natural products, and such products acquire value only if labour be required to produce or procure them. Wealth that is not used for direct consumption is capital. Capital is, therefore, the result of saving. Money is a common measure of value devised to facilitate exchange. Gold has been adopted almost universally as a suitable medium for this purpose, on account of its rarity, purity and general acceptability.

Capital is required in industry to provide plant and material, and to pay the wages of workmen till such plant is in operation and earning revenue. Industrial capital is largely held in small portions. The investments of insurance companies and trade unions are really largely the savings of relatively poor people. It is estimated that the British electricity supply industry, as distinct from manufacture, has £50,000,000 of capital and employs 30,000 persons.

Capital can only be raised, or people can only be induced to lend their savings, when a return in the shape of interest is made. Excessive interest in any industry is prevented by the tendency it would cause to attract fresh capital and so to set up competition.

Trade unions have hitherto been mainly employed in securing redress of grievances, suitable hours, wages and conditions of working. These things have been in the past of sufficient urgency to absorb the greater part of the activity of the unions. The present tendency is to endeavour to secure still further advances in the shape of shorter hours and higher wages. It should be remembered that the ability of industry to provide these advances depends largely upon its prosperity, and the trade unions' interests are therefore bound up with those of the industries with which they are associated.

The prosperity of this country has been built up mainly on two natural resources—an abundant supply of coal and a high class of labour. We have lost our lead in the first particular, and it is essential that we do not lose our supremacy in the second.

The possibility of the increase in production per unit of labour is indicated by the improved results which usually follow when piecework rates are introduced. Restrictive regulations enforced by some unions also militate against decreased costs. On the other hand, the managers of industry are responsible for the endless coal waste occasioned by the lack of standardisation and by imperfections of design. It is stated, for instance, that with trade catalogue matter there are 33 variations in width and 64 in length, whilst in newspapers there are 16 variations in width and 55 in length. It is estimated that these variations cost the public £22,000,000 each year. Accidents, which in 1919 were estimated to have caused a loss of £190,000,000, could be largely avoided by the adoption of safety methods.

It is to be remembered that greater production per unit of work does not mean less work in the aggregate. By the law of competition mentioned above the bulk of the saving is passed to the consumer, and the reduced price will increase the demand to an extent sufficient to provide more rather than less work. The extension in the use of electric lamps as the result of the decrease in their cost is an example.

In fine, the trade unions should aim to secure, as far as lies in their power, the prosperity of the industries with which they are associated, for the securing of good conditions for the workers depends upon this prosperity. It must also be remembered that at least one half of the existing waste and inefficiency must be charged against the management of industry.

Electricity Supply Wages.—The award of the special tribunal set up to consider the application of the employees in the electricity supply industry for a rise of 10s. a week was issued at the end of last week. It states in effect that no case has been made out for the increase asked, and that the wages at present paid are on the average higher than those paid in the principal industries using electrical power. On the other hand, the suggestion is made that the District Councils should be asked to reconsider their existing rates of pay, and pending their decisions the sliding scale should be suspended.

---

* Abstract of lecture by Mr. R. P Howgrave Graham, M.I.E.E., before the Junior Inst. of Engineers.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of
CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N. 17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited, and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL & CO., LTD., 36–39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

Electricity Supply Tariffs.

Next to reducing the flat rate per unit, which is the predominating system of charging for electricity consumed, the most important aim of progressive supply authorities would appear to consist in arriving at a tariff or method of charging which, whilst ensuring a reasonable return on the capital invested, will at the same time encourage the domestic load and increase the total output of the station without unduly elevating the "peak" of the daily graph. The absence of an effective storage system for electrical energy in bulk whereby the generating plant could be run at fairly constant load and the storage relied upon to meet peak demands is one of the industry's greatest handicaps in competition with gas for domestic requirements. Due to lack of storage, sufficient plant has to be installed to cope with the maximum demand upon the station, and as a result a considerable percentage of the total plant is either idle or running on light load for many hours out of the twenty-four.

Any tariff based on a flat rate per unit consumed must obviously bear inequitably on all save a few consumers who make very limited use of the service. Moreover, a flat rate is not encouraging to those who, realising the many possible advantages of electrical service in the household, nevertheless hesitate to adopt them on account of the directly proportional increase in the cost of energy. For this reason certain progressive undertakings have experimented with, and in some few cases actually adopted, discriminating tariffs which, whilst securing the costs of generation and fixed charges associated with the undertaking, enable them to supply additional energy at a very nominal price per unit. Thus the rateable value system, based on a fixed percentage charge per quarter on the assessment of the consumer's premises, plus one halfpenny per metered unit consumed, has a strong appeal in some areas, as also has the Croydon "all-in" tariff, based on actual measured floor space.

The domestic load is well worth encouraging, seeing that it may become when sufficiently developed an off-peak load. Such domestic electric appliances as cookers, irons, vacuum cleaners, hot-water devices, and even radiators or electric fires are not necessarily used mainly after sundown. In all probability their aggregate load would occur during the hours of daylight, thus tending to level up the lighting peaks. Any modified tariff, therefore, calculated to encourage this load by offering attractive rates should be welcomed and adopted. Nor is it sufficient merely to publish the change in semi-technical jargon on the quarterly demand notes or the usual forms of application for a supply of electricity. It is essential to bring their real meaning home to the comprehension of the consumer, who almost invariably suspects a trick whenever he is confronted with any revolutionary change in the method of charging for such a public service as electricity supply, gas or water.

I have known instances where consumers accustomed to the flat rate system have had the more favourable tariff thus brought to their notice, generally on the back of the usual quarterly account, time after time, and have still clung to the older alternative, although the change would not only have been financially favourable to them on their average existing consumption, but would have enabled them to install additional appliances and actually operate them without extra cost. It therefore behoves supply authorities who are sufficiently far-seeing to investigate and adopt these modern tariffs, to undertake also a vigorous educational policy even should it necessitate a house-to-house canvass by competent officials for the purpose of explaining to consumers the advantages which would accrue from a change over to the new tariff.

The necessary data for the compilation of new tariffs and the encouragement of the domestic load is already available in the records past and present of every electricity supply station, and it only needs a careful and intelligent analysis, taking into account the various classes of consumer catered for, to arrive at a basis of charging which should constitute an improvement upon the flat rate. The effective study of such existing data would appear to open up a new field for such accountants as already possess a good general knowledge of electricity supply accounting, working in conjunction with local assessors or architects able to furnish the requisite data concerning the house property in their districts. Given a general basis there will be many possible alternatives which only close and intelligent analysis by experts can whittle down to a practicable and acceptable solution.

Unemployed and Shirk.

The pernicious effects of the "dole" system were never better exemplified than in the recent case at Northampton, where the local Electricity Department applied to the Northampton Distress Committee for forty unemployed labourers for work in connection with laying electric light mains. As the work was in the county area, however, where the pretunities to make use of a direction finder are very limited, and the trials have been sufficient to show that such transmitters will be of great assistance to navigation on many other parts of the coast.

HIGH-VOLTAGE ELECTRICAL OSCILLATIONS.*

When electricity leaves its ordinary duties of providing power, heat and light, it can indulge in many playful exhibitions of a spectacular and wonderful character. On Friday, October 17, with Mr. R. P. Howgrave Graham as the "magician," an electric current of not much more than half a kilowatt was increased in voltage and frequency to a very high figure and made to perform many interesting tricks. Thus it lit a 100-volt lamp with three feet of aluminium shorting its terminals, and with 20,000 volts across them. Another lamp coupled with a transformer and a sheet of tinned iron was carried about with with no apparent connection to the source of supply, and yet induction was sufficiently great to light the lamp to full brilliance. Other experiments dealt with brush and spark discharges through air and through different materials such as wood, or the branch of a shrub, and also through Geisler and Crookes tubes. The different colours produced were very effective. The final experiment was simple but the result extraordinary. The lecturer rubbed a static conductor on his head, touched his watch with it and at the same moment a bell rang several feet away.

The experiments made one think that the problems of transmiting energy through the air or ether were all solved, and certainly energy can be transmitted over relatively large gaps at a not inconsiderable efficiency, but that is the present limit.

The spectacle of Mr. Howgrave Graham with a glowing halo round his head, or with sparks flying out of his finger tips, will not readily be forgotten by those who attended his demonstration.

NATIONAL ASSOCIATION OF SUPERVISING ELECTRICIANS—PRESIDENTIAL ADDRESS.

The presidential address of Mr. F. Gill, M.I.C.E., M.I.E.E., was delivered before a meeting of the National Association of Supervising Electricians, on Tuesday, October 14, 1924.

Mr. Gill prefaced his address by expounding the economic principles underlying wealth, capital and money. Wealth is the result of labour applied to natural products, and such products acquire value only if labour be required to produce or procure them. Wealth that is not used for direct consumption is capital. Capital is, therefore, the result of saving. Money is a common measure of value devised to facilitate exchange. Gold has been adopted almost universally as a suitable medium for this purpose, on account of its rarity, purity and general acceptability.

Capital is required in industry to provide plant and material, and to pay the wages of workmen till such plant is in operation and earning revenue. Industrial capital is largely held in small portions. The investments of insurance companies and trade unions are really largely the savings of relatively poor people. It is estimated that the British electricity supply industry, as distinct from manufacture, has £50,000,000 of capital and employs 30,000 persons.

Capital can only be raised, or people can only be induced to lend their savings, when a return in the shape of interest is made. Excessive interest in any industry is prevented by the tendency it would cause to attract fresh capital and so to set up competition.

Trade unions have hitherto been mainly employed in securing redress of grievances, suitable hours, wages and conditions of working. These things have been in the past of sufficient urgency to absorb the greater part of the activity of the unions. The present tendency is to endeavour to secure still further advances in the shape of shorter hours and higher wages. It should be remembered that the ability of industry to provide these advances depends largely upon its prosperity, and the trade unions' interests are therefore bound up with those of the industries with which they are associated.

The prosperity of this country has been built up mainly on two natural resources—an abundant supply of coal and a high class of labour. We have lost our lead in the first particular, and it is essential that we do not lose our supremacy in the second.

The possibility of the increase in production per unit of labour is indicated by the improved results which usually follow when piecework rates are introduced. Restrictive regulations enforced by some unions also militate against decreased costs. On the other hand, the managers of industry are responsible for the endless coal waste occasioned by the lack of standardisation and by imperfections of design. It is stated, for instance, that with trade catalogue matter there are 33 variations in width and 64 in length, whilst in newspapers there are 16 variations in width and 55 in length. It is estimated that these variations cost the public £22,000,000 each year. Accidents, which in 1919 were estimated to have caused a loss of £190,000,000, could be largely avoided by the adoption of safety methods.

It is to be remembered that greater production per unit of work does not mean less work in the aggregate. By the law of competition mentioned above the bulk of the saving is passed to the consumer, and the reduced price will increase the demand to an extent sufficient to provide more rather than less work. The extension in the use of electric lamps as the result of the decrease in their cost is an example.

In fine, the trade unions should aim to secure, as far as lies in their power, the prosperity of the industries with which they are associated, for the securing of good conditions for the workers depends upon this prosperity. It must also be remembered that at least one half of the existing waste and inefficiency must be charged against the management of industry.

Electricity Supply Wages.—The award of the special tribunal set up to consider the application of the employees in the electricity supply industry for a rise of 10s. a week was issued at the end of last week. It states in effect that no case has been made out for the increase asked, and that the wages at present paid are on the average higher than those paid in the principal industries using electrical power. On the other hand, the suggestion is made that the District Councils should be asked to reconsider their existing rates of pay, and pending their decisions the sliding scale should be suspended.

---

* Abstract of lecture by Mr. R. P Howgrave Graham, M.I.E.E., before the Junior Inst. of Engineers.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of
CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N. 17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited, and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL & CO., LTD., 36–39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

Electricity Supply Tariffs.

Next to reducing the flat rate per unit, which is the predominating system of charging for electricity consumed, the most important aim of progressive supply authorities would appear to consist in arriving at a tariff or method of charging which, whilst ensuring a reasonable return on the capital invested, will at the same time encourage the domestic load and increase the total output of the station without unduly elevating the "peak" of the daily graph. The absence of an effective storage system for electrical energy in bulk whereby the generating plant could be run at fairly constant load and the storage relied upon to meet peak demands is one of the industry's greatest handicaps in competition with gas for domestic requirements. Due to lack of storage, sufficient plant has to be installed to cope with the maximum demand upon the station, and as a result a considerable percentage of the total plant is either idle or running on light load for many hours out of the twenty-four.

Any tariff based on a flat rate per unit consumed must obviously bear inequitably on all save a few consumers who make very limited use of the service. Moreover, a flat rate is not encouraging to those who, realising the many possible advantages of electrical service in the household, nevertheless hesitate to adopt them on account of the directly proportional increase in the cost of energy. For this reason certain progressive undertakings have experimented with, and in some few cases actually adopted, discriminating tariffs which, whilst securing the costs of generation and fixed charges associated with the undertaking, enable them to supply additional energy at a very nominal price per unit. Thus the rateable value system, based on a fixed percentage charge per quarter on the assessment of the consumer's premises, plus one halfpenny per metered unit consumed, has a strong appeal in some areas, as also has the Croydon "all-in" tariff, based on actual measured floor space.

The domestic load is well worth encouraging, seeing that it may become when sufficiently developed an off-peak load. Such domestic electric appliances as cookers, irons, vacuum cleaners, hot-water devices, and even radiators or electric fires are not necessarily used mainly after sundown. In all probability their aggregate load would occur during the hours of daylight, thus tending to level up the lighting peaks. Any modified tariff, therefore, calculated to encourage this load by offering attractive rates should be welcomed and adopted. Nor is it sufficient merely to publish the change in semi-technical jargon on the quarterly demand notes or the usual forms of application for a supply of electricity. It is essential to bring their real meaning home to the comprehension of the consumer, who almost invariably suspects a trick whenever he is confronted with any revolutionary change in the method of charging for such a public service as electricity supply, gas or water.

I have known instances where consumers accustomed to the flat rate system have had the more favourable tariff thus brought to their notice, generally on the back of the usual quarterly account, time after time, and have still clung to the older alternative, although the change would not only have been financially favourable to them on their average existing consumption, but would have enabled them to install additional appliances and actually operate them without extra cost. It therefore behoves supply authorities who are sufficiently far-seeing to investigate and adopt these modern tariffs, to undertake also a vigorous educational policy even should it necessitate a house-to-house canvass by competent officials for the purpose of explaining to consumers the advantages which would accrue from a change over to the new tariff.

The necessary data for the compilation of new tariffs and the encouragement of the domestic load is already available in the records past and present of every electricity supply station, and it only needs a careful and intelligent analysis, taking into account the various classes of consumer catered for, to arrive at a basis of charging which should constitute an improvement upon the flat rate. The effective study of such existing data would appear to open up a new field for such accountants as already possess a good general knowledge of electricity supply accounting, working in conjunction with local assessors or architects able to furnish the requisite data concerning the house property in their districts. Given a general basis there will be many possible alternatives which only close and intelligent analysis by experts can whittle down to a practicable and acceptable solution.

Unemployed and Shirk.

The pernicious effects of the "dole" system were never better exemplified than in the recent case at Northampton, where the local Electricity Committee applied to the Northampton Distress Committee for forty unemployed labourers for work in connection with laying electric light mains. As the work was in the county area, however, where the prevailing rate is 1s. per hour, as compared with 1s. 1½d. in Northampton itself, only five men accepted a job. So long as the nation supports this policy, whereby perfectly fit and able men can live in comparative comfort without doing a stroke of work and are able to pick and choose such jobs as are offered from time to time, we shall never win back to our former industrial supremacy. What it means is that one portion of our industrial population is working part of its time solely to support another section, which exercises its prerogative of doing nothing and getting well paid for it.

Trade Follows the Light.

This excellent slogan, adopted by the E.D.A. in connection with its shop-window lighting campaign, has been made the title of an attractive brochure appealing to retail traders and shopkeepers throughout the country. The advantages of keeping attractive window displays well illuminated after closing hours have been abundantly proved. Under the Shop Hours Act many busy folk are debarred from investigating their local shop windows during the normal opening hours, but appreciate an opportunity to view the goods displayed for sale after dark when selections can be made and purchases arranged by proxy the following day. Late illumination of shop windows facilitates this inspection, and a carefully considered lighting scheme, in conjunction with a time switch, does not entail any very great additional expense upon the shopkeeper, seeing that special preferential tariffs are now almost universally in force for this service.

Those Breakdowns.

I regret another reference to this matter of electricity supply failures, but, on the principle that if you hit the nail on the head sufficiently often you will eventually drive it home, I feel justified in cataloguing another series of temporary breakdowns which have been reported during the past week or two. Preston, Peterborough, Carnarvon, Durham and Brighton were the areas principally affected, and various causes are assigned. In the case of Durham there has been a meeting of tradesmen to protest against the inconvenience caused by the failure of the supply of electric light during business hours. It seems that during the past three years there have been frequent failures, culminating in two successive Saturday nights during September. A petition is to be presented to the local supply company calling upon them to rectify the defects and put an end to the complaints. In the case of Carnarvon, the failure was in the bulk supply from the North Wales Power Company, and lasted for no less than three days.

ELEKTRON.

Too many voters would rather sit by the fireside than stand by the Party.

Change of Address.—On and after the 18th inst. the address of the London office of the Chloride Electrical Storage Co., Ltd., will be 137, Victoria St., London, S.W.1. Telephone, Victoria 6308 (5 lines); telegrams, "Chloridic, Sowest, London." The Exide depot and showrooms will remain at 219/229, Shaftesbury Avenue, London, W.C.2. Telephone, Regent 8070 (5 lines); telegrams, "Exidedepo, Phone, London."

ELECTRICAL ENGINEERING—GRADE I.*

Solutions to 1924 Examination Questions of the City and Guilds Institute.

BY EDWARD HUGHES, B.Sc. (Eng.), A.M.I.E.E.

(*Continued from page 544.*)

Q. 6.—A flux density of 10,000 lines per square centimetre is required in an iron ring of 5 square centimetres cross-section and 20 centimetres mean diameter. If the permeability at this flux density is 1,000 and the ring has 500 turns, calculate the exciting current. How would the exciting current be affected if the cross-section were halved, other things remaining the same?

A 6.—The flux in a magnetic circuit is given by:—

$$\Phi = \frac{1.256\, IT}{\text{Reluctance}}$$

where IT = ampere-turns due to winding,

and reluctance $= \frac{l}{\mu a}$

where l = length of magnetic circuit in cm.
a = section „ „ „ „ sq. cm.
and μ = permeability of magnetic circuit.

In the above question:—

$$l = \pi \times 20 = 62.8 \text{ cm.}$$
$$a = 5 \text{ sq. cm.}$$
$$\text{and} \quad \mu = 1000.$$

$$\therefore \text{reluctance} = \frac{62.8}{1000 \times 5} = 12.56 \times 10^{-}$$

Also total flux = flux density × section of circuit
= 10,000 × 5 = 50,000

$$\therefore 50{,}000 = \frac{1.256\, IT}{12.56 \times 10^{-3}}$$

$$\therefore IT = \frac{50 \times 12.56}{1.256} = 500$$

But $T = 500$
$\therefore$ exciting current = 1 ampere.

The exciting current required to set up a given flux density is independent of the cross-section of the magnetic circuit. Thus from the above expression, we have:—

$$\Phi = Ba = 1.256\ IT \times \frac{\mu a}{l}$$

$$\therefore B = 1.256\, IT \times \frac{\mu}{l}$$

$$\therefore I = \frac{Bl}{1.256\ T\mu}$$

an expression that does not involve the cross-sectional area a.

This expression could have been employed to calculate the exciting current required in the first instance; thus,

$$I = \frac{10000 \times 3.14 \times 20}{1.256 \times 500 \times 1000} = 1 \text{ ampere.}$$

---

* Books recommended are *Elements of Electrotechnics*, by Young (7s. 10d. post free), and *Technical Electricity*, by Davidge and Hutchinson (13s post free), both from S. Rentell and Co., Ltd., 36, Maiden Lane, London, W.C.2.

Generally speaking, however, it is much better to memorise only the most important relationships and to deduce from them any other relationships that may be required.

(*To be continued.*)

ELECTRIC PASSENGER LIFTS.*

BY H. MARRYAT (Member).

(*Continued from page* 543.)

No. 6 of this series of curves represents a condition of particularly comfortable starting, and I have chosen this curve to illustrate in Figs. 6 (*a*) and 6 (*b*) the derived velocity and acceleration curves.

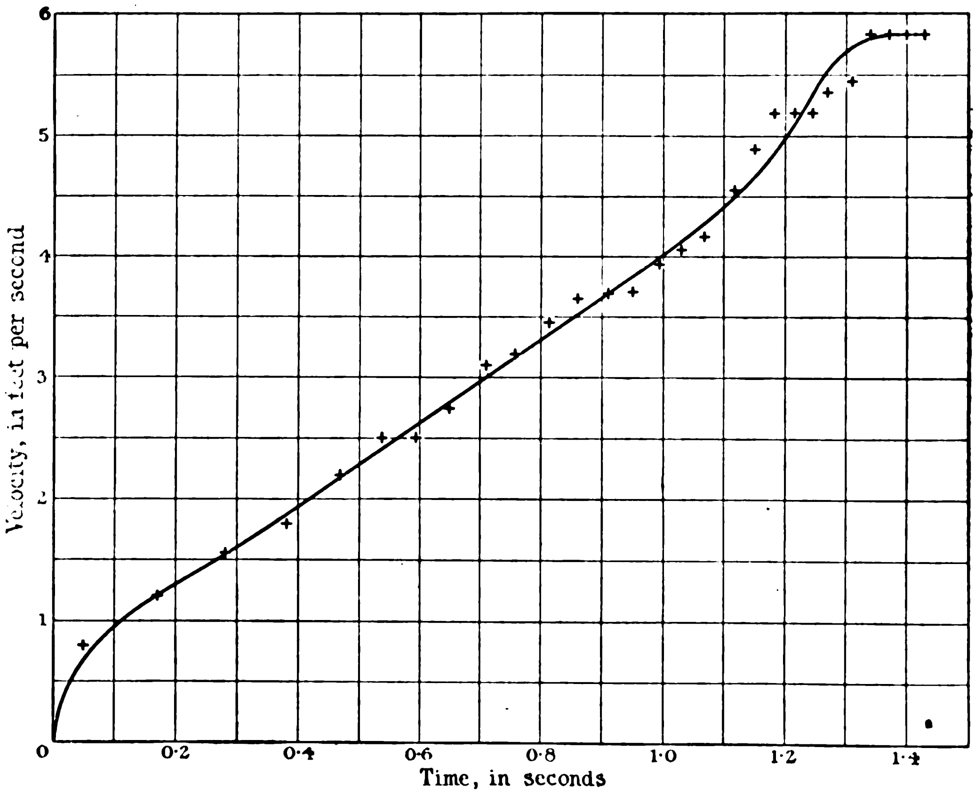


FIG. 6 (*a*).

In Fig. 6 (*a*) it will be observed that the lift attains a maximum velocity in 1.4 sec. In Fig. 6 (*b*) it will be noticed that the acceleration over the first fifth of a second is not plotted. This is because it has not been found possible to obtain accurate measurements from this part of the film. As more information about this part of the acceleration curve is of great importance, I am now arranging apparatus to investigate in detail what happens in this first fifth of a second. It will also be noted in Fig. 6 (*b*) that the acceleration proceeds in a series of periodic leaps. This is a feature of the whole of these records. At first the explanation seemed simple, because in most instances there are eight clearly marked periods, and it so happens that on the normal controller usually experimented with there are eight batches of starting resistances in the armature circuit. Further examination shows that, although the starting contacts undoubtedly affect the shape of the curve, they are responsible for it. For instance, if the number of starting contacts is reduced, the number of periods shown on the acceleration curve is increased.

I am not as yet prepared to explain the cause of this periodic acceleration; perhaps some light will be thrown upon it during the discussion. The variety of the forms obtained and the fact that on repeating the same experiment the same form is repeated, seems to show that the shape is governed by various forces acting sometimes together and sometimes in opposition depending upon the conditions of starting.

It may be noted, in reference to Fig. 6 (*b*), that the steps in acceleration indicated are too rapid to have any physical effects upon the passengers, for the purpose of considering which question an average curve should be drawn. In this sense the curve indicated in Fig. 6 (*b*) is a good one, provided that the unplotted part in the first fifth of a second does not descend from too great a height.

As a matter of interest I propose to show by means of lantern slides a few other examples of these curves. The first represents the acceleration of an hydraulic goods lift, and the next two represent, I think, a somewhat daring experiment, when a large passenger lift running at 400 ft. per min. and driven by a 21-h.p. motor was switched direct on to the main without any intermediate resistance. The first is taken under conditions of maximum load and the second with minimum load.

It will be observed from the figures given that the 600-ft.-per-min. lift will carry 26 per cent more passengers per hour than the 300-ft.-per-min. lift will do, or to carry the same number of passengers may be of 20 per cent. less capacity. There is not, so far as I know, any lift running at 600 ft. per min. in this country, nor to my knowledge is there one running at over 400 ft. per min., but I am quite convinced that, with the increasing site values in our cities, there is opportunity for the economic use of higher speeds.

---

* Paper read before the Institution of Electrical Engineers

Having discovered the total capacity required in a certain building and decided upon the speed and capacity of each lift, the number of lifts required will follow as a matter of course.

Before passing on to the consideration of other lift problems, it is interesting to note here the experience of the London Electric Tube Railways, kindly given me by the operation manager, Mr. A. P. Thomas.

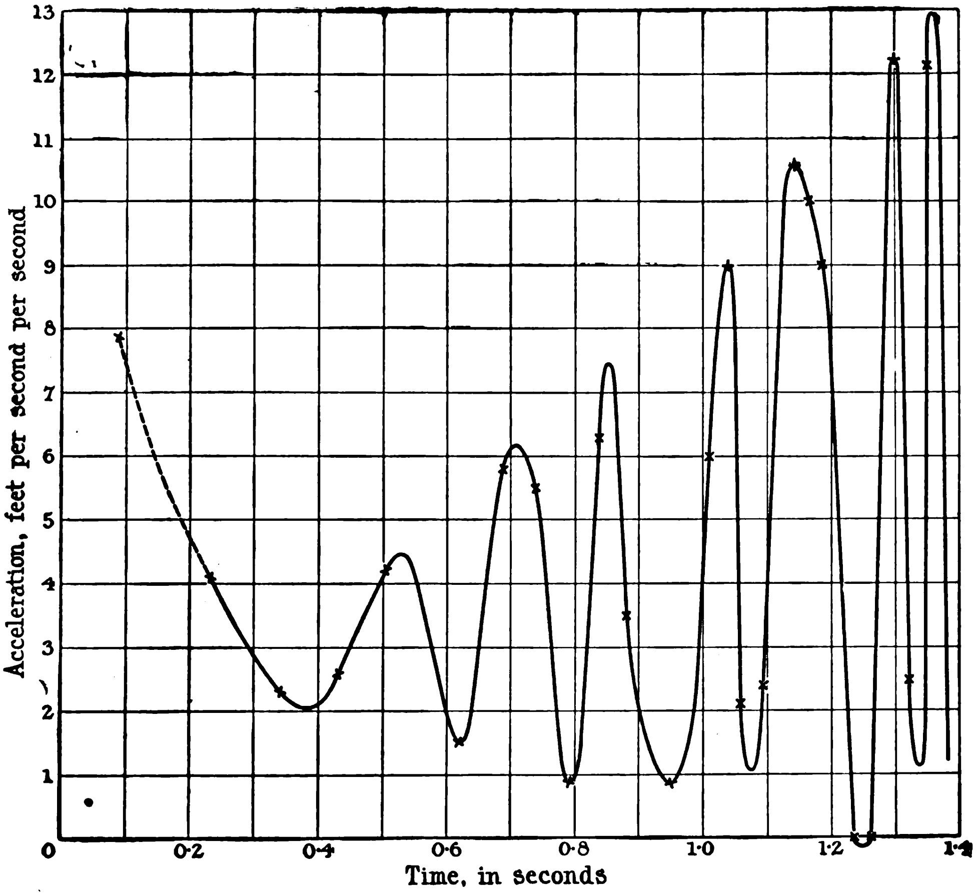


FIG. 6 (*b*).

The number of lifts installed in a Tube station depends upon the volume of traffic, and is approximately :—

For 7,000 passengers per day—2 lifts.
For 10,000 passengers per day—3 lifts.
For 13,000 to 30,000 passengers per day—4 lifts.

The number is, to a certain extent, dependent upon the depth of the shaft. With a 4-lift equipment and a depth of shaft of 72 ft., a general average service of 2 mins. 18 secs. per lift can be observed, allowing :

7½ secs. for preparing lift.
30 secs. for loading lift.
7½ secs. for starting lift.
24 secs. for running lift.
45 secs. for discharging lift.
24 secs. for running lift.

Or a total of 138 secs. for the round trip, or 26 trips per hour.

The speeds of the lifts on the London Electric Railways are about 180 ft. per min., except at Hampstead, where the shaft is deeper than that at any other station, viz., 181 ft. There the speed is 200 ft. per min.

There is a tendency to increase the speed of Tube railway lifts to meet the desire of the travelling public for faster travel. A lift service, however well run, compares unfavourably with an escalator service, and lifts have been replaced by escalators at a number of stations. No lifts at all are provided on the new stations north of Edgware Road, a convenient escalator system having been introduced. For all shafts of a depth of 60 ft. and under, the escalator provides a better means of transport, but for a shaft above this depth high-speed lifts are desirable.

The winding engine giving motion to the ropes may be fitted with a drum to which the car and counterweight ropes are positively attached, or with a V-groove sheave transmitting motion to the ropes by friction, as a pulley does to a belt. Had I been reading this paper twenty to twenty-five years ago, I should at this point no doubt have entered upon a strong advocacy of the sheave drive, but this is no longer necessary, as most makers have now adopted this arrangement. (*To be continued.*)

The Socialist Party : Bolshies with bobbed hair.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 190.

I desire to find a fault on an underground cable. Are there other tests, other than Murray's loop test, which may be applied? If so, I would appreciate practical and technical details.—"D. WILLIAMS."

(*Replies to Question No.* 190 *must be received not later than October* 25, 1924.)

Answers to Questions.

QUESTION NO. 184.

I would appreciate details of a three-phase 6,600-volt transmission system (overhead). What is the function of the guard wire? What type of earth plates are used? Is every lattice-type pole earthed, etc.?—"FREQUENCY."

REPLIES TO QUESTION NO. 184.

The first prize (10s.) has been awarded to Mr. S. J. Berryman, Gustavus Road, Camborne, Cornwall, for the following reply:—

When it is desired to erect an overhead transmission line the following are the chief factors to be considered in regard to its design:—Mechanical strength of line conductors, mechanical strength of poles and supporting devices, safeguards against broken or falling wires, reduction of energy losses, including brush discharge, or, as it is sometimes termed, corona, leakage over insulators and reduction of inductive voltage drop.

Conductors.—The general rule in this country is to use copper for overhead line work, although aluminium is slowly gaining ground and no doubt in time will replace copper to a great extent, especially in new undertakings. A point in favour of aluminium is that its surface is protected from atmospheres laden with moisture and acid fumes due to an oxide forming on the outside. Although the conductivity of aluminium is only about 60 per cent. of that of copper, yet owing to density an aluminium wire is only about half the weight of a copper wire of the same length and conductivity.

Overhead conductors are usually carried on wooden or steel poles, although reinforced concrete poles are being introduced. Swedish round fir poles have been found most satisfactory in the British Isles. When using steel poles they should be of the built-up lattice type. Each pole should be earthed; the best form of earth plate consists of a large copper plate buried in a damp situation with coke as a bed, the connecting lead being of a heavy cross-section and either bolted or riveted to the plate, also soldered as a precaution. Steel poles should be set in concrete, as this preserves the metal, also each pole should be set in a cast-iron sole-piece, to which it should be well bonded.

When spacing the poles the number and sizes of the wires to be carried are the chief considerations, but climatic conditions with regard to heavy winds, etc., must not be forgotten. The average number of poles per mile is from 40 to 44, but with very heavy lines it is sometimes found advisable to use 50, or even 52.

At points where the line crosses the main road a cradle should be used. This consists of wires stretched from one pole to another to prevent the transmission wires from falling in case of a breakage.

The guard wires are carried on insulators on top of the poles to provide an earth circuit in case of lightning.

Energy Losses.—There is always a loss of power on an H.T. line due to leakage of the current, although it may be kept within reasonable limits if the lines are well separated and very carefully insulated. The leakage takes place between the wires either directly through the intervening air, especially in damp weather, or over the insulators. On lines which carry a very high voltage brush discharge takes place between the wires. If the wires are not well separated a considerable loss takes place between the wires.

When brush discharge is taking place a faintly luminous feathery form may be observed, usually accompanied by slight hissing or crackling sound.

Transposition of Wires.—When a number of alternating current transmission lines are run side by side the alternating magnetic field set up by the currents in one line may set up E.M.F.'s in the other lines, which would, of course, unbalance the voltage and affect the line drop.

By transposing or crossing, or, as it may be termed, twisting the wires, this disturbing action may be avoided, and the effect produced in one section of the line is exactly counterbalanced by that produced in another. The idea of transposition can be seen in a multicore cable, whose individual cores are twisted together. This type of cable gives us the most perfect form of transposition obtainable. The inductive effect of such a cable on neighbouring conductors is almost nil.

Overhead cables are not transposed more than necessary, as it makes the wires harder to trace in case of trouble and is liable to cause short circuits. Lines not transposed very often act satisfactorily. The general rule is to cross them every two or three miles.

Section switches should be used at intervals, so that in cases of breakdowns or renewals the line may be cut dead at certain points.

Another important part which must not be forgotten is the lightning arresters for protection against atmospheric influences

Barbed wire or any other method may be used at the foot of the poles to guard against persons climbing them. Although these few notes are small when considering the erection of a 6,600-volt transmission line, it may give "Frequency" a little idea of what is required.

The Second Prize Winner's reply will be published in due course.

A HUNDRED YEARS OF ELECTRICAL ENGINEERING.*

(*Continued from page* 568.)

The difficulties were enormous. The carbon brush was not invented until 1885, and commutation in a reversible motor with copper brushes caused great trouble, armature construction and winding was in its infancy; the suspension of the motor and the method of gearing it to the car axles were problems which were solved only after much experience. Rapid progress was made after about 1887, and the closing years of the century saw an enormous development, the elimination of horse tramcars throughout the world and the electrification of a number of city and suburban railways.

Of the various systems of collecting the current, only two have survived for street-cars, viz., the usual overhead wire and the exceptional underground conduit; in the case of railways there is no necessity for a conduit and the conductor rail is carried on insulators above the ground level.

Although 500-volt D.C. supply has been standardised for street tramways, the relative merits of D.C. and A.C. for electric railways has been a burning topic for over twenty years, and is now perhaps more burning than ever. It is somewhat akin to the battle of the gauges in the early days of steam railways, for it involves in many cases the problem of through running, if not now, in the not very distant future. Although the three-phase system was successfully installed in Northern Italy, it has grave disadvantages, and the battle now is confined between direct current at an increased voltage of, say, 1,500 to 2,000 volts, and single-phase alternating current. In the latter case there is, moreover, a further question as to the best frequency to adopt, this being usually either 25 or 16⅔. The development of the A.C. commutator motor to the stage where it was applicable to traction took place during the first few years of this century, and, although in itself it is inferior to the D.C. motor, it introduces so many simplifications and economies in the transmission of the power from the generating station to the train that experts are very divided as to the relative merits of the two systems for main-line electrification.

I can only just refer to the applications of electrical power to chemical and metallurgical processes. Some of these are purely electro-chemical, others are purely thermal, while in many processes the electric current performs the double function of melting and electrolysing. The possibility of electroplating was discovered as early as 1805, but the commercial application of electro-chemistry on a large scale was impossible before the development of the dynamo. Within the last thirty years the provision of an abundant supply of electrical power has led to the creation of enormous electro-chemical industries; I need only instance the production of aluminium, carborundum and calcium carbide. These industries have usually been established near a hydro-electric plant and provide a load of very high load-factor.

I turn now to what may be called both the earliest and the latest application of electricity; that is, its use for transmitting intelligence. One of the greatest factors in the development of our modern life has undoubtedly been the network of wires and cables which has spread over the whole earth, making possible an almost instantaneous transmission of intelligence and interchange of opinions. In the early days of electrical science the discovery of a new property of electricity was followed by attempts to utilise it for this purpose. As early as 1746 there are records of the use of frictional electricity for the purpose, and distances up to four miles were tried. In 1774 Lesage, of Geneva, proposed 26 wires in earthenware pipes with pairs of pith-balls at the end of each wire, which flew apart when the conductor of a frictional machine was brought near the other end of the wire. A current of electricity was unknown until Galvani's discovery in 1789, and Volta's pile was first constructed in 1792. Carlisle in 1800 found that water was decomposed by passing the current from a Volta pile through it, and this was the basis of the telegraph proposed by Sömmering in 1809, in which 26 wires ended in 26 metallic points arranged in a row along the bottom of a kind of aquarium. By means of a lettered keyboard at the sending end the current could be applied to any wire, and a stream of bubbles caused to rise from the appropriate point, each point being duly labelled with its appropriate letter. The magnetic effect of the electric current was discovered in 1819, and immediately replaced the previous methods in efforts to develop an electric telegraph; except for the attempts to make a high-speed chemical telegraph, all subsequent telegraph systems have employed the magnetic effect of the current. A great many of the fundamental inventions of telegraphy were made in the 'thirties; the list includes the needle instrument of Cooke and Wheatstone, the sounder of Henry, the dot-and-dash inker of Morse, and the use of the earth as a return by Steinheil. Although the needle instrument is now obsolete, the sounder and Morse inker are still commonly employed. Many have been the devices for increasing the amount of traffic which can be worked over a single line, either by the simultaneous use of the line by a number of operators, as in the quadruplex and multiplex systems, or by punching the messages on paper tapes, which can then be fed into an automatic transmitter working at a speed ten to twenty times that attainable by a manual operator. In the most up-to-date systems the perforation of the tape is done by the operators working an ordinary typewriter keyboard, and the received message is printed in ordinary type, a single wire carrying eight messages simultaneously, four in either direction, at a speed of 40 words per minute.

The need for telegraphic communication between countries separated by water was so much the greater because of the slowness of other means of communication, but the difficulties in laying and maintaining 2,000 miles of insulated wire on the bottom of the sea must have appeared almost insuperable to the early workers; fortunately, however, there were men who had the necessary vision and courage. The flimsiness of the early cables suggests that the pioneers underestimated the magnitude of the problem which faced them, which was perhaps fortunate. A cable was laid between Dover and Calais in 1850; it lived only a single day, but it was replaced in the following year by a successful cable.

The first cable was laid across the Atlantic in 1858, and, although in the light of our present knowledge we know that it could not have had a very long life, its failure after a few weeks of preliminary communication was primarily due to misuse owing to the ignorance of those in charge. Although much costly experience had been gained in the laying of cables in various parts of the world since this first attempt to span the Atlantic, the success of the second Atlantic cable in 1866 was largely due to the scientific ability of Kelvin and to his enthusiastic and untiring application to the project at every stage of the manufacture and laying of the cable. In addition to this, he not only designed the receiving instruments, but superintended their manufacture in Glasgow and their installation and operation. The success of the Atlantic cable was to a large extent a personal triumph for Lord Kelvin. Although numerous improvements have been made in the details of cable manufacture and in the transmitting and receiving apparatus, no outstanding change has been made in recent years in the methods of submarine telegraphy.

---

* Address before the British Association, at Toronto, by Professor G. W. O. Howe, D.Sc., President of Section G.—Engineering.

(To be continued.)

Reviews of Books, &c.

[*Books noticed in this column will be sent from* ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage* (*minimum 2d.*), *and orders will be appreciated.*]

THE MOTOR MANUAL (25th edition).—(Temple Press, 2s. 6d. net).—This practical handbook has now reached its 25th edition (690th thousand), while, since its introduction in the early days of the popular motoring movement its sale has totalled over 650,000 copies. Successive editions have kept pace with motoring developments, and its main object has always been to serve as an all-round textbook on the fundamental principles and construction of motor-cars and their management and upkeep; in short, it provides all the information the motorist should have. It is written in a lucid, non-technical style, and is profusely illustrated, there being an additional 120 new illustrations in this edition and a very instructive frontispiece, comprising a large-scale section of an up-to-date car with overhead valves, front-wheel brakes, etc. Every part of a car is dealt with, from engine to road wheels, and the reader should have no difficulty in obtaining a correct idea of lubrication, carburation, magneto and coil ignition systems, the gearbox, the working of a differential, how front-wheel brakes are operated, the latest types of wheels and low-pressure or balloon types, new types of bodywork, etc. Large sections of the book deal with simplified technical definitions, formula, useful horse-power tables and charts, motoring law, touring, an extensive glossary of technical terms explained in simple language; in fact, "The Motor Manual" is a veritable motoring encyclopædia in condensed form, indispensable to the beginner and invaluable for reference to the experienced motorist.

An intelligent citizen is almost anyone who thinks before he votes.

I.E.E. Informal Meeting.—At the informal meeting due to be held on December 8 a lecture entitled "A Walk Round the Pretoria Power Station" will be given by Mr. G. M. Clark, M.A.

Various Items.

Wanted.—An advertiser wants to purchase two D.C. generators. For details see small adverts. page.

Bargain.—A reader has for sale a four-valve A.J.S. wireless receiver set, of which particulars are given in our small-advertisement column. This is a bargain which ought to be snapped up quickly. It represents real value.

Visit.—On Saturday next, 25th inst., the members and friends of the National Association of Supervising Electricians will meet at 3, Salisbury Sq., Fleet St., E.C.4, at 6.45 p.m., in order to visit the works of the United Newspapers, Ltd.

Troubles in Electrical Plant.—Readers who are in charge of dynamos and motors will be interested in the advertisement of Prof. Miles Walker's book on the *Diagnosing of Troubles in Electrical Machines*, which appears on another page. It is worth following up.

The Faraday House Journal.—The issue for Michaelmas term is now before us It contains, as usual, interesting notes on the progress which has been made by old students in all parts of the world, as well as some reviews and several practical articles which are certain to appeal to all readers.

China.—The report on the commercial and industrial situation in China has just been issued by the Dept. of Overseas Trade, and may be obtained from H.M. Stationery Office or ELECTRICITY Office, price 1s. 8d. net post free. It contains a clear record of the state of British trade with China and the prospects of increasing it in the near future.

A Vickers Contract.—For the Harworth Main Colliery, Messrs. Barber, Walker have ordered from Vickers, Ltd., a complete and exactly duplicate set of winding engine mechanical parts. The main contractors are the Metropolitan Vickers Electrical Co., Ltd., and the winding engine is said to be the largest electrically driven winder in this country.

Wireless for Whalers.—The use of directional wireless reception is constantly extending, and it is now being applied to the special requirements of vessels engaged in whaling operations. The whaler, *Sir James Clark Ross*, which recently sailed from Cardiff for the Ross Sea, has been fitted with a Marconi direction finder, and is taking with her five others for use on board the small boats associated with her in whaling.

Meetings.—The Junior Inst. of Engineers will meet on Friday, 24th inst., lecturette "Powdered Fuel," by F. F. Evans (member). Also on Friday, 31st inst., lecturette, "Audio-frequency Transformers," by H. J. N. Riddle (assoc. mem.). And on Friday, November 7, lecturette, "History and Construction of the Fire Engine," by H. C. Jones (assoc. mem.); slides and diagrams. All at 39, Victoria St., at 7.30 p.m.

Japan.—The report on the commercial and industrial situation in Japan has just been issued by the D.O.T., and may be obtained from H.M. Stationery Office or ELECTRICITY Office, price 2s. 8d. net post free. This report will interest a very large number of readers, because there is quite an important section dealing with British trade and the possibility of increasing it in the future. We can therefore cordially recommend it to all firms in the trade.

Quotations Wanted.—The Municipal Council of Johannesburg invite tenders for an electric arc welding generator set complete with all accessories.——The South African Rys. and Harbours Board invite tenders for converter plant, switch cubicles, transformers and motors.——The N.S.W. Govt. Rys. and Trys., Sydney (Chief Electrical Engineer's branch), invite tenders for motor-driven boiler feed pumps, White Bay Power House.——The Electricity Department of the City of Cape Town invite tenders for the supply and delivery of electric motors. Specifications, etc., from the D.O.T. (Room 52), 35, Old Queen St., London, S.W.1.

The Electrical Industry in Germany.—According to the British Commercial Secretary in Berlin, the slight improvement which set in in August was maintained in September. There was everywhere a demand, and only the exceptional shortage of money hindered the placing of new orders. As regards the individual branches of the industry, business in power plant improved. In the telegraphy and telephony branch orders increased somewhat. Business in automatic telephone apparatus continued to make good progress. The factories manufacturing electro-medical apparatus were better employed. Orders for fittings for tramcars increased, while those for electric full-gauge railways were satisfactory. The turnover in incandescent lamps was greater than in the preceding quarter, but smaller than in the corresponding period of last year.

The I.E.E. Wiring Rules.—We have already made editorial reference to the new (eighth) edition of the *I.E.E. Regulations for the Electrical Equipment of Buildings*, otherwise and more familiarly known as the *Wiring Rules*. The copy which we had then received was bound in paper. The cloth-bound edition is now on the market, price 1s. 6d. net, and it may be ordered from S. Rentell and Co., Ltd., 36, Maiden Lane, London, W.C.2, price 1s. 8d. post free. In our opinion the cloth binding is a decided improvement and well worth the extra sixpence.

The Women's Engineering Society.—In connection with the work of the Women's Electrical Committee of this society, a drawing-room meeting will be held at Lady Parsons' house, 1, Upper Brook Street, W., on Wednesday, November 12, at 4.30 p.m., to discuss the formation of a Women's Electrical Association. A paper will be read by Mrs. Matthews (Grad., I.E.E.) on the need to interest women in electrical development, followed by a short speech by Miss Beatrice Irwin on electrical development in America. Representatives of various women's organisations, together with other representative people in the electrical world, will be present.

Suspended Animation.—We note with very sincere regret that it has been resolved not to hold any Electro Harmonic Concerts during the present season. For some time past the membership has been dropping steadily, due doubtless to the fact that the halls used have lacked that air of cosy sociability which characterised the King's Hall of the Holborn Restaurant. A general meeting was called to discuss the matter, and ultimately it was resolved that when times were more propitious and a cosy central meeting place was obtainable, then the committee would take immediate steps to prepare for a new session. It was felt the wisest course to pursue after a useful and happy life of 38 years. Let us hope that the present state of suspended animation will not be unduly prolonged.

Heavy Oil Engines.—A meeting of the Birmingham Electric Club will be held at the Grand Hotel, Colmore Row, on Friday, the 24th inst., at 7 p.m. prompt, when a lecture will be given on "Heavy Oil Engines for the Generation of Electricity," by Mr. C. W. Chapman, B.Eng. The lecture will deal with moderate power units for electrical generating stations up to approximately 1,000 kw., and the considerations affecting design of oil engines for electrical drive, such as reliability, low cyclic variation, close governing, and high speed of rotation, as well as other factors where parallel operation of alternators is necessary, such as synchronous speeds, speed regulation, governing, angular deviation and resonance. General particulars of oil engines, such as the semi-Diesel, Diesel, and the four-cycle cold-starting oil engine, will be described by means of lantern slides.

The Wizard Electric.—Evidently the publicity department of the Siemens and English Electric Lamp Co. believe in training the young idea in the virtues of their lamps by appealing to that side of their character which seeks for amusement while at the same time familiarising them with the name, so that when in due course they develop into householders they will automatically ask for "Siemens" lamps when they purchase from their local electrical store or ironmonger. A few weeks back we referred to their "Roulette" game, and now we are in receipt of another novelty called the "Wizard Electric," which is based on the well-known race game of our childhood, yet will prove a fascinating source of amusement to electricians of all ages. The story is well told in ten verses of poetry describing the conversation between Fairy Light and Wizard Electric, while the game card itself is illustrated with fifteen well thought out sketches excellently printed in colour and dealing humorously with the advantages and disadvantages of various forms of illumination, from the ancient farthing dip, through oil lamps, matches and gas, right along to the end of the chapter, when Fairy Light touches the magic switch and frightens King Darkness away. The introduction of gas is very fairly treated as a direct advance, while faulty fuses cause a loss of score in two places, thus adding zest to the competition. Evidently electricians ought not to suffer for lack of amusement this winter, and we can cordially recommend all contractors and trade readers to write at once to the Siemens Company at 30b, Upper Thames Street, London, E.C.4, and ask for one of these new games. But don't leave it until too late and then blame us.

A well-printed trade card has been issued by **Mr. Chas. Selz**, of 83, George St., Baker St., London, W.1. On it there are excellent reproductions in colour of fourteen of the many types of silk lamp shades manufactured by him. It will interest all electrical contractors and dealers, and should most certainly be written for if not already received.

Correspondence.

TRADE TERMS TO EDUCATIONAL ESTABLISHMENTS.

To the Editor of ELECTRICITY.

Sir,—Some few months ago I had put before me a circular issued by the London University College Stores Department to certain electrical firms asking them to quote for certain supplies, and to give the best trade and cash discounts that they would allow.

On taking this matter up with some of the larger manufacturers of electrical accessories, and also with the Electrical Wholesalers' Federation, I have been able to report to my committee that in the opinion of such traders the University College should not be allowed the discount which is recognised as applying to the trade.—I am, yours faithfully,

LEONARD G. TATE
(The N.E.C.T.A., Ltd.)

Trade Notes.

Radio Circular R.7471a has been issued by the **B.T.-H. Co., Ltd.**, of Rugby. It gives illustrations and details of their Radio valve, Type B5, for rectification and amplication, and will prove of interest to all wireless traders and dealers.

The September issue of the *A.S.E.A. Journal* is to hand from the **Swedish General Electric Co., Ltd.**, of 5, Chancery Lane, W.C.2. It contains, as usual, interesting articles illustrating and describing the latest types of apparatus which have been manufactured by the company, together with articles of general practical interest to electrical engineers, and will therefore appeal to many of our readers, to whom it will willingly be sent on application.

The Transfer of Heat to Water, by Arthur Ross, F.R.C.S., is the title of a well-printed 32 pp. pamphlet which has just been issued by **Messrs. Arthur Ross, Hotchkiss and Co.**, of 1, Glengall Road, London, S.E.15. It deals in an interesting manner with the engineering problems which are involved in the transfer of heat to water, and incidentally advertises the advantages of the Hotchkiss water circulator, for which they claim many advantages in regard to the increase of the working life of boilers, the reduction of fuel costs and the beneficial effect generally of using it in all steam production plants. The list should therefore prove of direct value to all central-station engineers and readers who are in charge of steam-raising plant generally.

Catalogue No. 7, issued by the **Engineering and Lighting Equipment Co., Ltd.**, of Sphere Works, St. Albans, Herts, deals with the extensive range of industrial lighting fittings which are manufactured by the company, among the important features being the anti-break disc, for which they claim it enables gasfilled lamps to be used under otherwise impossible conditions, and are now used extensively by a number of the largest lighting installations in the country. Other items included in the catalogue are ship-lighting fittings and cargo clusters, mining fittings, which will interest colliery electricians, and shop-lighting fittings generally. The list should therefore be in the hands of all installation contractors, and will willingly be sent on application.

CASING AND CAPPING.
BLOCKS, CLEATS,
BOARDS FOR SWITCHES
in stock and made to any design.
ACCUMULATOR CASES
and BATTERY BOXES
Made to Order.
J. F. & G. HARRIS, Ltd.,
Timber Merchants and Moulding Manufacturers,
SAWING, PLANING, MOULDING & GENERAL WOODWORKING MILLS
58g, WILSON ST., FINSBURY, LONDON, E.C.
Telephone No: 1168 London Wall. Please write for Illustrated Price List.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

OCTOBER 31, 1924.

CONTENTS. PAGE

The Presidential Address to the Institution of Electrical Engineers .. 585
Our Wireless Corner .. 586
Electrical Engineering—Grade I. .. 588
Lighting the Wireless Exhibition .. 588
Current Topics .. 591
Electrical Installation Work .. 592
Simplex Z.I.R. Conduits and Fittings .. 593
The Glover Wiring System .. 593
Questions and Answers by Practical Men .. 595
The Benjamin Electric at Wembley .. 596
Practical Electrical Engineering Hints .. 597
A Hundred Years of Electrical Engineering .. 598
Various Items .. 6 0

THE PRESIDENTIAL ADDRESS TO THE INSTITUTION OF ELECTRICAL ENGINEERS.

In his inaugural address to the Institution of Electrical Engineers, delivered on October 23, Mr. William B. Woodhouse had much to say concerning the position and prospects of the electricity supply industry, with which he has been so long and intimately connected. Some of the more salient features of the address are reproduced below, but, needless to say, the original will repay careful study. Concerning the Institution itself, Mr. Woodhouse emphasised the beneficial results derived from the recognition by the Council of sectional interests, and the creation of other organisations, such as the British Engineering Standards Association, the Electrical Research Association, and the Electrical Development Association, to meet new needs as they arise. Our duty is to repay, so far as we can by working for the common good, the benefits which we have received from the work of others.

The rapid growth of the electricity supply industry makes it more than usually important to consider the problem of training younger men to carry on the growing work before them. Flexibility is an important consideration, and Mr. Woodhouse recommends that the training of administrative and executive officials should include not only technical instruction and practical experience in the supply industry, but also experience in one or more sections of the manufacturing industry. The accountancy side of the business should also be studied.

The very fact that electricity supply has developed so rapidly during the last 20 years has resulted in claims being made for the use of electricity which exceed the present probability of fulfilment. Electricity is not a panacea for industrial and social ills, and it behoves engineers to speak out just as definitely when unjustifiable claims are made for it as when it is unfairly attacked.

One of the most notable achievements of electrical engineering has been increasing the illumination obtainable from a given amount of electricity no less than six-fold since the beginning of this century. To-day electricity is the cheapest illuminant, and its use for lighting purposes is growing at an unprecedented rate. Nevertheless, it is probable that less than 20 per cent. of the houses in the country are wired for and connected to the public supply. The majority of existing consumers live in houses of six or more rooms, but in London 45 per cent., in Manchester 77 per cent., and in the West Riding 82 per cent. of the houses have five rooms or fewer. The dwellers in these houses are potentially smaller consumers of electricity, but the cost of distribution per house is practically the same as for larger houses. It is important, therefore, to reduce the cost of distribution and to stimulate the use of electricity for domestic purposes other than lighting. The present consumption per head of population for lighting purposes in this country is about 10 units per annum, which figure would probably rise to 40 or 60 units per annum were all houses lighted electrically. The difficulty lies in the cost of distributing mains and apparatus and were the cost of fuel halved the effect on the price of electric light would be but trifling. The cost of distribution for lighting purposes adds some 300 per cent. to the cost of production, whereas the distribution of milk adds only 100 per cent. to the wholesale price.

While the cost of electricity for lighting is primarily determined by the cost of distribution, the principal factor in the case of power supply is the cost of generation. The advantages of centralisation now permit, in the majority of cases, the supply of electricity at prices definitely below those of private generation, in addition to the less direct but still important advantages of convenience. Further economies will accrue from the growth and interconnection of stations and the complete supersession of small stations in industrial areas—a work which is progressing steadily. A careful study of works using both motive power and steam for process work shows that the advantages of combining the two are often illusory and that economy would result from separating the two. The use of the colliery winding engine is an example of the steam engine being retained on account of characteristics which are believed to make it specially suitable, but in all the principal coalfields public electricity supply is now available on a scale which will permit the simplest and cheapest form of electric winding motor to be used satisfactorily without special balancing equipment.

The relative price of a heat unit in the form of coal and of electricity—unfavourable as the comparison is to the latter—is not the criterion of its value unless account be taken of the efficiency of utilisation. When this is done it is found that electric heating is suitable and economical for some applications, but in other instances its cost is prohibitive. It is important to consider the measure of co-operation which should exist between suppliers of coke, gas and other fuel and those of electricity. The most efficient use of coal for power production is measured by the coal consumption per unit, but, on broader grounds, a process which consumes more coal but yields a greater profit per ton may be preferred. Coal distillation is therefore a matter which the electrical engineer must regard as being within his province. The coking processes are the more important, and include those in use by the gas industry and by the coke-oven industry. Producer processes which result in complete distillation of the carbonaceous matter and its conversion to gas are, from the present standpoint, less important. The adoption of any established commercial process of distillation would, however, introduce into the electricity supply business an element of speculation which is foreign to the industry as it exists to-day, and might have the effect of raising the rate of interest which the industry has to pay for its capital—an important consideration seeing that the costs in a principal station are roughly as follows: Coal, 50 per cent.; capital, 30 per cent.; operating costs, 20 per cent. The most suitable process to adopt would be one that permitted the quantity and nature of the by-products to be varied most readily to meet changing markets, and would be commercially justifiable even when a large proportion of the products was used in the production of electricity.

In regard to the thermal efficiency of the present type of generating plant we are steadily approaching the limits. The boiler may have an efficiency of 85 per cent.; the steam turbine an efficiency ratio of 87 per cent.; and the alternator an efficiency of 97 per cent.; or an overall efficiency of 72 per cent. *of that attainable with the heat cycle employed.* The actual overall efficiency, however, rarely exceeds 20 per cent., owing to the limitations of the heat cycle itself, and it is important to raise the efficiency of the heat cycle by such means as reheating the steam, progressive heating of the feed water, and, particularly, by raising the temperature and pressure of the steam. Even so, however, there can be no revolutionary improvement.

A greater measure of public goodwill is likely to be obtained by giving consumers a clear understanding of the principles which determine the charges for each class of electrical service. The question of framing tariffs is of the utmost importance for, unless great care be exercised, profitable consumers are penalised to enable less profitable ones to be supplied. There is a wide field for the development of electricity supply for all purposes, but unprofitable development at the expense of existing users, or of the public as a whole, is to be deprecated.

The limits of aggregation of generating plant in single stations can now be foreseen with fair accuracy, and it is clear that generation for any considerable area of supply in this country will be effected at more than one station. Inter-connection thus becomes an important factor, the advantages, disadvantages and special problems of which are discussed by Mr. Woodhouse in some detail. The rapid increase in the cost of switch-gear and protective apparatus as the size of the supply system increases is one of the most serious disadvantages inherent to the use of three-phase current, and it is within the bounds of possibility that we may revert in some instances to the use of high-tension direct current and variable voltage systems.

The whole electrical industry has undoubtedly a great admiration for the work done by the Electricity Commissioners under the most difficult circumstances but, as regards further legislation, it is to be hoped that an opportunity will be given for the industry to show what can be done without further measures of compulsion or restriction. To a peculiar degree, perhaps, the electrical industry works under ever-changing conditions, both within and without the industry itself, and a minimum of legislation will probably lead to a maximum rate of progress.

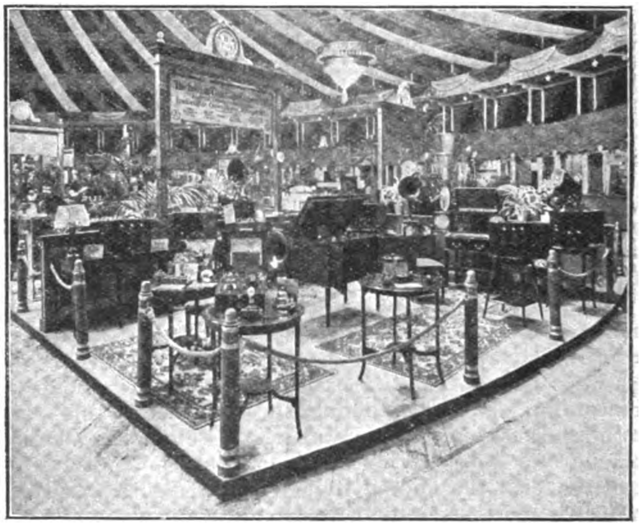
Those who pessimistically point to the comparatively low consumption of electricity per head of population in this country should remember that the development of electricity supply in countries where water power is available and coal is dear has been more rapid than in this country, not necessarily due to a greater spirit of enterprise, but primarily because electricity was there the best or only economic solution of the power problem. The lines which development is following in all parts of the world have been indicated or established principally by British engineers, and there is no evidence, says Mr. Woodhouse, that the ability of our engineers in any way falls below that of engineers of other countries.

We are particularly glad to hear on such good authority that there are no grounds for self-depreciation amongst electricity supply engineers in this country, and, speaking for ourselves and, we believe, the vast majority of our readers, we trust that theorising politicians may be persuaded or prevented from putting their fingers into the electrical pie!

Our Wireless Corner.

B.T.-H. ENTERPRISE.

The British Thomson-Houston Co., who are among the pioneers in the electrical industry generally, have also contributed largely to the successful development of the wireless section of the trade, and at the recent show at the Albert Hall exhibited some very fine instruments and details of the higher class which attracted considerable attention. We give a view of their principal stand, which occupied an imposing corner position, while they also had a display at one of the side bays. A very representative feature of the high-class products of this firm is seen on the stand illustrated in the fine and ornate cabinet in the centre, which encloses a new 6-valve radio receiver of the Radiola type, and embraces all the later improvements for general reception that could be desired by the most exacting enthusiast. Other types of instruments of this class we noted were a portable 3-valve receiver with an internal frame aerial, and with the batteries



B.T.-H. STAND AT ALL-BRITISH WIRELESS EXHIBITION, ALBERT HALL.
(Note the new Radiola 6-valve cabinet receiver in middle of stand.)

of small size but of sufficient capacity also enclosed in the one case—about the size of an ordinary suit case. A companion case, comprising a complete loud-speaker and 2-valve amplifier, was also shown, as designed to accompany the other, but equally adaptable for any standard receiving set. Many other details of interest were shown and are included in the firm's descriptive catalogue of radio material.

Broadcast Reception at Sea.

Marconi apparatus specially designed for the reception of broadcast programmes at sea has now been fitted on a dozen ships, and is giving very satisfactory results. This installation consists of the Marconi marine V4, which is similar to the standard V4 set, with the addition of two protective tuning circuits. It is arranged to operate the loud-speakers or telephones through transformers, so that any chance of the high tension supply becoming ineffective through the action of salt water, etc., is obviated. One of these sets was carried by the motor yacht *Naz-Perwer* on a recent voyage to Norway. At Bergen the Aberdeen station was received clearly during daylight, and at night Aberdeen and Newcastle were heard up to about 100 miles north of Bergen. The Chelmsford station was received during practically the whole of the cruise, including times when the vessel was landlocked in the fjords 200 miles north of Bergen. During the regular voyages of the D.P.L. steamship *Perth* between London and Dundee, the London, Chelmsford and Newcastle stations are received strongly and with perfect clarity, and delivered by means of a loud-speaker to passengers, who greatly appreciate this entertainment. Other ships fitted with the Marconi marine V4 include the C.P.S. liner *Marglen*, the R.M.S.P. Co.'s *Arcadian*, the Campbell Line vessel *Lady Moyra*, and a number of private yachts.

A special single-wire aerial is erected for use with the broadcast receiver, so as to avoid any interference with the ship's ordinary wireless services. At present the broadcast receiver is only used when transmission by the ship's own apparatus is not taking place, but most promising experiments are in progress with a view to making it possible to receive broadcasting while the ship's transmitter is in operation.

New Wireless Transmitters and Receivers.

We have received from Messrs. Marconi's Wireless Telegraph Co., Ltd., the following pamphlets, No. 219/2, "Portable and Semi-Portable Receivers, Type R.P." and No. 232 on "Wireless for Coastal and Harbour Services." Like the other pamphlets of their class, they are most excellent productions, each pamphlet dealing with its subject in detail, and the value and interest are particularly added to by the number and perfection of the illustrations that are given. The technical information relating to the apparatus is clear, concise and full. It is not necessary for us to comment on the apparatus, as its design and efficiency are unchallenged.

The first pamphlet describes a range of portable receivers, and gives the points considered in the design of each type, together with the necessary technical data, which enable its sphere of usefulness to be determined. The pamphlet contains a list of stations transmitting time signals, meteorological reports, and other items of general interest.

The second pamphlet deals fully with the application of wireless signalling for coastal and harbour services, and in addition to ordinary wireless telegraph and telephone working, describes the "Call" transmitter and receiver, automatic time signal equipment, direction and position-finding apparatus, and also gives much information on the Marconi wireless beam transmitter. The pamphlet also includes a selection of beacon stations transmitting navigational signals, and a selection of direction-finding stations of the world.

Two leaflets, No. 1032 and 1033, have also reached us. The former describes in detail the Marconi installation for ships' lifeboats. Illustrations of the equipment and diagrams showing method of erection are given. The second leaflet is a supplement to pamphlet No. 226 and describes and illustrates a 50-watt aircraft-artillery co-operation set.

In view of our reference to the above pamphlets, new developments in the use of wireless signalling are always of interest. A Fairey seaplane has been built for use between the plantations of a company in British Guiana and the nearest town. The Marconi Co. have equipped this machine with wireless apparatus. This seaplane has been designed to carry white men who fall ill with fever on the plantations to the nearest place where treatment can be obtained. The journey, though little more than 200 miles, takes 17 days by river owing to rapids, etc., and the journey is so difficult that many sick men have not survived it. The seaplane will accomplish the journey in just over two hours, and this would appear to be the biggest saving in time so far obtained over any route. Each plantation has its own ground station, and the Marconi installation on the machine enables telegraphic and telephonic communication to be carried on both ways.

New Trade Literature.

Radio Pamphlet R7358, which has just been issued by the B.T.-H. Co., Ltd., of Rugby, gives illustrations and details of Radiola VI., which is a combined six-valve wireless receiver and loud-speaker entirely self-contained. No aerial, earth connection, nor external batteries are required for excellent reception in the loud-speaker within a radius of 60 to 70 miles from the regular B.B.C. stations. It should therefore prove of interest to trade readers and dealers who specialise in the sale of receiving sets of the very highest quality, suitable for mansions, public halls and similar establishments.

Electricity in Agriculture.—The E.D.A. is forming a sub-committee to deal with the commercial aspects of electricity in the farm and on the land.

Meetings.—The Inst. of Production Engineers will meet at 7.30 p.m. on Monday, November 3, at the Engineers' Club, Coventry Street, W.1. Mr. B. Brett will read a paper on "Drop Forging" (slides). Visitors cordially invited.

Report of Test on Parker Lower Temperature Carbonisation Plant. (H.M.S. Office, 11d. post free.)—This pamphlet has just been issued by the Fuel Research Board, and is, as stated in the title, a test carried out on the Parker Lower Temperature Carbonisation Plant which was installed at Barugh, Barnsley, at the works of Low Temperature Carbonisation, Ltd. It contains much information from the point of view of engineers who wish to investigate this problem, containing as it does a description of the plant, the operation, the arrangements which were made for the test and the general observations on the capacity and handling of the plant, together with a summary of the results obtained.

ELECTRICAL ENGINEERING—GRADE I.*

Solutions to 1924 Examination Questions of the City and Guilds Institute.

By Edward Hughes, B.Sc. (Eng.), A.M.I.E.E.

(*Continued from page* 579.)

Q. 7.—Sketch and describe a form of battery switch suitable for maintaining a constant voltage at the terminals of the load while the battery is being charged.

A. 7.—A battery regulating switch must be so constructed that the supply voltage can be varied without interrupting the circuit and also without shortcircuiting one or more of the end cells. The construction usually adopted is to make the moving element with a main finger *A* and an auxiliary finger *C* as shown in Fig. 4,

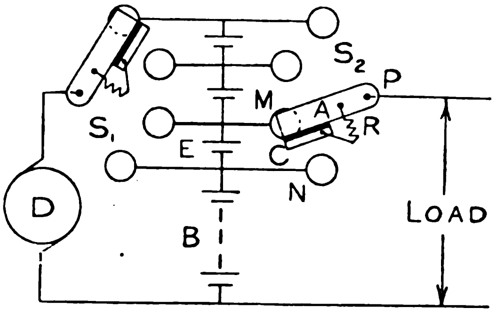


Fig. 4.

A being pivoted at *P*. *C* is attached to, but insulated from *A*, except for a spiral resistance *R*. Normally, *A* is on a stud, say, *M*, so that the current from battery *B* has a direct path to the mains via *M A P*. The auxiliary arm *C*, being then between studs *M* and *N*, is carrying no current.

To reduce the supply voltage, the switch is moved towards *N*, the spacing between the studs being such that *C* makes sufficient surface contact with *N* before *A* leaves *M*. Cell *E* is then being bridged by *R*, which must be such that the normal discharge current of the cell is not exceeded. The moment that *A* leaves *M*, the whole of the load current passes via *N C R A P*, and continues until *A* makes contact with *N*. Obviously the width of *A* must be less than the clearance between the studs.

When it is desired to charge the battery simultaneously with the battery supplying a load requiring a constant voltage, two battery regulating-switches are employed as shown by S_1 and S_2 in Fig. 4. The number of cells being charged from dynamo *D* is controlled by S_1, whilst the voltage across the load is adjusted by S_2.

If the dynamo were always connected across the whole battery, S_1 could be eliminated; but it is generally preferable to be able to control the number of end cells undergoing charge owing to their discharges being unequal. Thus, the cells at the top end of battery in Fig. 4 always begin to gas before those nearer the main portion of the battery; and by the installation of S_1, such cells can be cut out when they show signs of being fully charged.

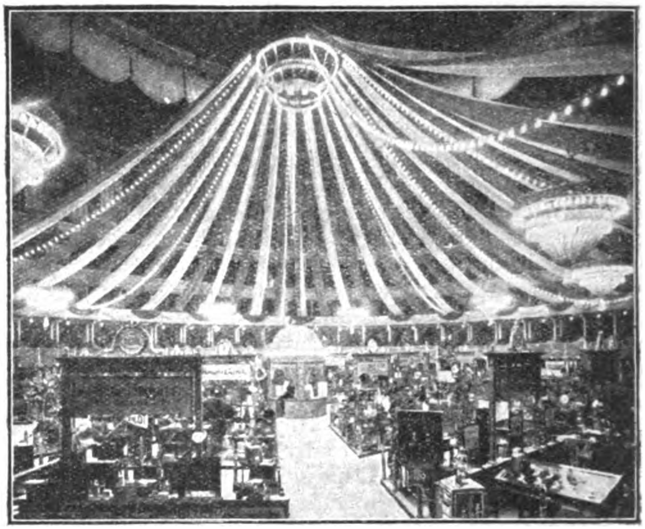
(To be continued.)

---

* Books recommended are *Elements of Electrotechnics*, by Young (7s. 10d. post free), and *Technical Electricity*, by Davidge and Hutchinson (13s post free), both from S. Rentell and Co., Ltd., 36, Maiden Lane, London, W.C. 2.

LIGHTING THE WIRELESS EXHIBITION.

It was fitting that the illumination of the Albert Hall for the Annual Wireless Exhibition should possess a number of interesting features and innovations. Ordinarily, the building is lighted exclusively from the dome by means of powerful lighting units, and the appearance can hardly be called entrancing; but for this one occasion the method of lighting employed gave the hall a festive appearance, and yet its usual dignity and grandeur were retained. This was largely accounted for by the fact that, for the first time, white gasfilled lamps were used throughout the installation, thus effectively eliminating the glare associated with ordinary clear lamps. The illustration shows the main scheme adopted. A three-tier corona was suspended high up in the building, from which seven strips radiated in graceful lines toward the second tier of the boxes. The lighting was further supplemented by means of eight specially designed corona fittings and the lamps surrounding the central kiosk.



The 1,700 lamps employed consumed some 600 amps, and necessitated special switching arrangements. Measurements taken of the illumination on the floor level gave an intensity of 18-20 foot candles, and it proved to be satisfactory in every way.

Institution Wiring Rules.—The F.D.A. has set up a sub-committee for consideration of criticisms raised by the members of the Association concerning the latest edition of the Wiring Regulations.

The Motor Liner "Lochkatrine."—The *Lochkatrine*, a twin-screw motor liner of about 9,500 gross tons, owned by the Royal Mail Steam Packet Co., left Belfast on the 16th inst., after undergoing a general overhaul by Messrs. Harland and Wolff, Ltd. Electric light has been installed throughout the vessel, there being over 500 separate lights, in addition to 15 lamps, each of 1,500 candle-power, for the working of cargo at night, and there is efficient ventilation, both natural and mechanical. There are four Diesel-driven generators, each having an output of 400 kilowatts. The deck and engine-room auxiliaries are all electrically driven, the total h.p. of the motors being over 1,300, of which the largest is 180 b.h.p., while wireless and submarine signalling apparatus of the latest type has also been installed.

Benjamin again!

The Benjamin Illuminating Engineers suggest the Exhibition at Wembley to you as an excellent example of

CORRECT ARTIFICIAL LIGHTING

Advert. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N. 17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application.

Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited, and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL & CO., LTD., 36-39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

A Wise Decision.

In many towns now operating electric tramway services, which, due to the number of years of service, are approaching the end of their useful lives, the question will sooner or later arise whether such services are to be entirely reconstituted at very considerable expense, or replaced by something more modern and better suited to present-day traffic conditions. Such a stage has been reached by the Chesterfield tramways, a comparatively limited service, comprising some two miles of single track and one and a half miles of double track. Faced with the prospect of heavy expenditure on track and rolling stock renewals, the Chesterfield Corporation sought the advice of Mr. Alfred Baker, general manager of the Birmingham Corporation Tramways, who advocates the total scrapping of the existing system and its replacement by electric trolley omnibuses.

Another decision to abandon the existing worn-out tramways system has been arrived at by the respective corporations of Ashton-under-Lyne and Oldham, and the service now connecting the two towns is to be scrapped and a trackless trolley omnibus system substituted. To this end ten single-deck omnibuses have already been ordered, and will presumably be put in commission as soon as they are available. This change over to trackless trolley vehicles preserves the advantages of working the service from a central power station without the concomitant expense of laying and maintaining new tramway tracks. Presumably the existing overhead trolley wires will be utilised and the worn-out tram-rails recovered when next the road is due for repair. This policy of change to a more modern and flexible system of urban and inter-urban transport marks the beginning of the end of the tramways era, although it may well mark the more rapid growth of the light railway running at comparatively high speeds over fenced in tracks.

Electric Fires: A Warning.

Now that the cold days of early winter are with us, there is a noticeable and gratifying increase in the use of electric fires and radiators, especially those of the smaller portable types which can be switched on for occasional heating and moved about either in the room itself, or from room to room in a house, according to requirements. Although in itself a considerable convenience, and one of the chief recommendations of this class of electric heating device, it, nevertheless, constitutes a source of danger if due regard be not had to the location of the fire when juice is on. The small bowl fires and other designs, in which a reflector serves to concentrate the heat beam in a definite direction throw out a quite considerable volume of heat to a no inconsiderable distance from the element which is situated at the focus of the reflector.

If placed too near any inflammable material and left in position for quite a brief period, the smallest of these fires is quite capable of causing a conflagration. This fact was brought home to me the other day when a certain bowl fire of well-known make was temporarily moved away from its usual position and left facing a chair upholstered with what turned out to be a somewhat inflammable material. Within a minute the patch of upholstery facing the beam was visibly smoking, although the distance away from the source of heat was upwards of two feet. For a similar reason the base or pedestal of these small fires requires to be heavy and substantial, rendering them as stable as possible and unlikely to be upset. At least one maker has designed his bowl fire so that, if inadvertently knocked over, it falls with the projector pointing upwards and away from the carpet or lino.

British Contracts for British Firms.

We have always staunchly advocated the placing of important contracts for machinery and other manufactured products in this country, even where the competitive foreign tenders were apparently more attractive when viewed without regard to the state of local unemployment and taxation to provide doles. When the taxpayers' money is at stake, as in the case of industries subsidised by the Government, this principle of keeping work at home is even more vital, and a case in which the late Government granted a subsidy and at the same time failed to ensure any necessary expenditure under the subsidy benefiting British workers has been brought to the notice of all candidates at the election. It seems that quite recently the Labour Government granted a subsidy to the British Sugar Beet Industry, but omitted to make a stipulation that any factory built and equipped to take advantage of this subsidy should be built and equipped by British labour.

This omission was the more serious in that it is since reported that practically the whole of the plant for equipping one of the first factories to be built under the subsidy is to be ordered from the Continent, no British tenders being invited. This is a highly unsatisfactory state of affairs, in view of the fact that there exist British firms with the necessary manufacturing experience and ability for carrying out this class of work. It behoves the Government to take care of this principle in granting any further subsidies in aid of struggling British industries. If the taxpayer is compelled to assist these industries which from their nature and importance to our national well-being need financial assistance to enable them to establish themselves, it is only right that the money thus invested on behalf of the taxpayer should remain in the country when it is paid out for work done or goods supplied.

Wembley.

Now that the greatest exhibition the world has yet seen is on the eve of closing its doors, it is pertinent to ask whether the venture was justified. The question and its answer revolve around the true definition of an exhibition, and in this connection there was a very interesting talk broadcast from 2LO recently by Lt.-Col. Cole, C.S.I., O.B.E., Director of the Exhibitions and Fairs Division of the Department of Overseas Trade, in which the distinction was very clearly drawn between exhibitions and fairs. According to this authority, a fair is primarily for immediate and specific business, whereas an exhibition is a judicious mixture of business, education, and amusement. The B.E.E. at Wembley comes under the latter category, and as such can be pronounced an unqualified success. For some time there have been critics of the gloomy order unwilling to admit that the undertaking has been in any way successful.

These pessimists base their criticisms on the purely financial aspect of the venture as represented by preliminary organising expenses on the one hand and net gate receipts on the other. It was fairly obvious at the outset that even thirty million people visiting the B.E.E. during its six months' existence would not in gate money alone have justified the enormous outlay involved in building and equipping such a magnificent spectacle as was presented to the world at Wembley. Then there have been the trade grumblers among exhibitors who came in with the idea that they were going to book large orders and contracts of sufficient magnitude—over the counter, so to speak—to recoup them for their total outlay and leave them several thousand pounds on the right side. These people participated under an entirely mistaken impression. The B.E.E. was in no sense of the word a trade show or industrial fair; on the contrary, it was a unanimous effort on the part of leading British firms, co-operating with the Colonies, to demonstrate the possibilities of the Empire.

That this object has been achieved there is very little doubt, and the beneficial effects of the Exhibition will be felt for some years to come by those manufacturers whose policy was sufficiently bold. The Wembley display and the recorded attendances by visitors from all parts of the world must be viewed in its broadest aspect, and not from the restricted viewpoint of disgruntled exhibitors who have not benefited by immediate contracts. If the goods shown at Wembley were of the right quality, orders will come along in due course and for some years ahead. New customers will have been added to the books of many of the exhibiting firms, whilst the notes recorded by interested visitors from overseas will inevitably bear fruit as and when the occasion serves. So far as the home electrical trade is concerned, it behoves the many firms exhibiting in the B.E.A.M.A. section of the Palace of Engineering to energetically follow up the interest aroused by the E.D.A. and other displays, and not allow it to flag with the closing down of the B.E.E.

The Social Side.

I must say that I read and follow with keen interest the publications and proceedings of the associations formed to carry on the friendships which have been created between men who have studied in central technical colleges such as Faraday House, or big factories like the British Westinghouse Works at Trafford Park. The Old Faradians are scattered all over the world, and the same remark applies to the members of the ex-British Westinghouse Association, of which Mr. L. S. Richardson is the live wire as hon. sec. I have before me Part 3 of Vol. 1 of "Inter Nos," which, as a publication of variable frequency, is the official organ of the association, and records with more or less humorous veracity the doings and sayings of the many thousands (more or less) of its members. The correspondence column is really choice, and the letters sent to the hon. sec. must indeed make him blush for his misdeeds. I can but hope that he and the members of his committee will speedily reform, and that the force of their brilliant example will cause all "bad lads" to become "good lads" without any further delay. I am positive that would prove such a shock to Mr. Richardson that he and the rest of the committee would have to buy several dogs at the expense of the funds. They could, of course, be duly kicked when the accounts came up to be passed by the members in full general meeting. Never mind about any howls. It would do them good.

Elektron.

ELECTRICAL INSTALLATION WORK.

By C. Sylvester, A.M.I.E.E., A.M.I.Mech.E.

Solutions to the Questions in Grade I, C. and G. Examination on May 6, 1924.

(*Continued from page 566.*)

Question 7.—What is the reason for earthing the metal sheathing of an installation, and what governs the size of the earth wire?

The reason for earthing metal sheathing of an installation is to reduce the metal to earth potential should it become accidentally alive through the failure of the insulation between the conductor and the sheath. This applies especially to three-wire systems where the neutral is always earthed. If the metal sheathing of the outer conductors were not earthed, if a breakdown of insulation occurred the same potential would exist between sheathing and earth and between outer and earth; this is dangerous to persons likely to touch the sheathing.

The size of earth wire to be used is governed by the Regulations for the Electrical Equipment of Buildings issued by the Institution of Electrical Engineers. Here, Rule 102, under the heading of "Earthing Leads" (*a*), states:—

> Every conductor used as an earthing lead shall be of high conductivity copper, protected against cor-

rosion by tinning or otherwise, and against mechanical injury, and its sectional area shall not be less than one-half that of the largest of the conductors to be protected, provided that no conductor of less sectional area than 0.0045 square inch (7/.029 in.) shall be used as an earthing lead.

(*To be continued.*)

SIMPLEX Z.I.R. CONDUITS AND FITTINGS.

The vital importance of combating effectively the ravages of rust in this age of "Iron and Steel" is at once apparent when one considers the enormous expenditure which Government Departments, municipalities, and large manufacturers are called upon to bear in the maintenance and replacement of corroded ferrous structures.

We are, therefore, not surprised to hear that Messrs. Simplex Conduits, Ltd., as leading manufacturers of electric conduit wiring material, have endeavoured to produce steel conduit and fittings which will not only withstand corrosion by rusting, but will be free from the inherent defects of the earlier processes of hot and electro-galvanising, and the success which has attended their researches in this direction are reviewed in a most interesting booklet they have just published, and which we recommend most cordially to the careful perusal of every installation contractor, foreman and wireman.

It is entitled, "The Evolution of Simplex Z.I.R. (Zinc-Impregnated Rust-proof) Conduits and Fittings," and in its eight pages of text sets forth very clearly the importance of the problem of protection against corrosion as affecting the durability, general efficiency and useful life of an electrical installation and, after enumerating at length the high qualities of the enamel used by the company on its standard enamelled conduits, it goes on to describe briefly the process of manufacture of the new Z.I.R. conduits. The advantages claimed for it are given in detail, and mention is also made of the fact that the new conduits are now being used in the largest electrical contracts now being undertaken in this country. The schedule of prices which accompanies the pamphlet shows that their cost is claimed to be but little more than that hitherto charged for hot galvanised material, and the same small ratio of increase is also applicable to conduit fittings, distribution boards, etc., treated under the new process. Samples are being sent out to the trade broadcast for inspection and test, and we quite expect that this new conduit will cause a flutter of excitement in the installation world.

Ideal Homes Exhibition, Olympia, 1925.—The E.D.A. has made arrangements for a domestic electrical display at Olympia in March next in conjunction with the Electrical Lamp Manufacturers' Association.

Tenders Accepted.—Sphinx Electric Supplies (Ireland), Ltd., of Clanwilliam Place, Lower Mount Street, Dublin, have secured the contract for the supply of "Sphinx" electric lamps to the Board of Works, and to the Post Office of the Irish Free State.

The Birmingham Electric Club.—The 14th annual ladies' night will be held in the Windsor Room, Grand Hotel, Colmore Row, on Friday evening, November 7. The programme will be as follows: Reception, 7 p.m.; dancing, 7.30-1 a.m.; whist drive, 7.30-10.45. Tickets, 6s. each, will include light refreshments during the intervals and throughout the evening. Application for same should be made to N. Deykin, 193, Station Road, Wylde Green, Birmingham.

THE GLOVER WIRING SYSTEM.

The employment of methods of house wiring involving the use of vulcanised rubber cable sheathed with a lead alloy and special devices for bending has extended considerable during recent years. There are already several such systems, and in the introduction of a new one by a firm with the prestige and reputation of Messrs. W. T. Glover and Co., Ltd., one would naturally expect some real improvement and a departure from the commonplace. This expectation is not disappointed, for the Glover's wiring system, which has been designed and planned out in consultation with Mr. F. C. Raphael, M.I.E.E., the well-known expert, possesses some new and very interesting features, as set forth below.

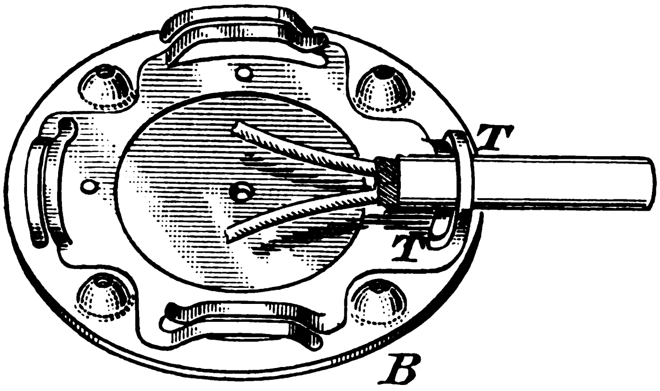


FIG. 1.—UNIVERSAL BACK PLATE.

The cable itself follows standard lines, being V.I.R. type to C.M.A. standard size, sheathed with an alloy of lead, which makes it sufficiently stiff not to sag when fixed on the surface of a wall or ceiling in the ordinary way, and at the same time leaves sufficient flexibility for comparatively sharp bends and neat work. It is made single, twin flat and three core flat. For fixing the cable the firm advocates the well-known buckle clips with which electrical wiremen are familiar; in the particular form which Messrs. Glover supply there is ample width, the clips are substantial and should be durable, and their appearance is good. The holes for screws or fixing pins are countersunk, thus preventing the possibility of projecting heads damaging the cable sheath.

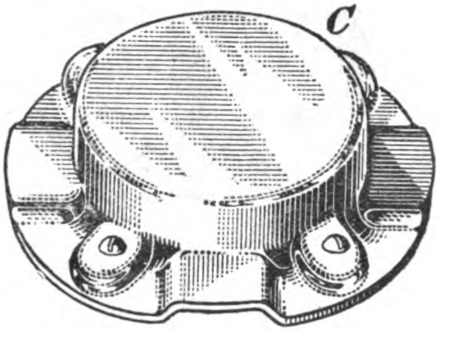


FIG. 2.—UNIVERSAL JUNCTION BOX COVER.

The particular features of the system to which attention must be drawn are, the method of bending at fittings and junction boxes (which is done without any loose parts or special tools, and is virtually automatic) and a new departure in labour saving by the entire omission of wood blocks.

The method of bonding will be clearly seen from illustrations, Figs. 1 and 2, of the universal back plate and junction box cover, which are steel stampings of a very substantial thickness finished in a bronze lacquer of smart appearance. On to the back plate a tinned brass bonding ring is riveted, and it will be seen that at every point of entry there are a pair of projecting flat springs of special shape, between which the cable is placed. On screwing down the cover the upper spring is pressed tight against the cable and follows its shape, whereas the lower spring maintains a contant tension, so that perfect contact is always maintained. This solves the problem which has always been experienced of maintaining a permanent contact of a soft metal like lead without soldering. It will be noted that where the back plate is tapped for the reception of the holding down screws, the metal is raised, so that screws of a good length are employed and there is nothing "niggly" or "fiddly" in the assembly. The cover is raised at four places to correspond, and accordingly goes down automatically into the correct position, there being no waste of time in getting the clearance hole of the cover and the tapped hole of the back plate to register.

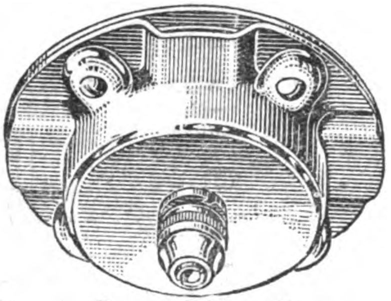


FIG. 3.—PENDANT BOX, COMPLETE.

In the case of the junction box the back plate is fixed to the wall by one countersunk screw, but for the fittings, the back plates of which are otherwise exactly similar, three screw holes are employed.

In place of ceiling roses, boxes similar to junction boxes are employed, but with a well-made cord grip projecting from the centre (Fig. 3) with three countersunk fixing holes as above-mentioned. Thus, no block or ceiling rose is required. All necessary loop connections are placed in the box, but there is no need to make these with the box fixed to the ceiling, and with the workman's hands and head in an awkward position. The back plate can first be fixed to the ceiling with the cable in any convenient position, then all connections can be made and the flex fitted in the cord grip, after which the cover is placed on to the back plate and simply screwed on.

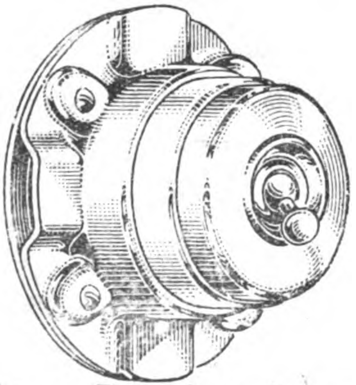


FIG. 4.—RIGHT ANGLE SWITCH.

A very similar arrangement is followed in the case of the switches (Fig. 4), and here also the saving in labour in erection is very marked. The switch is sent out permanently fixed to the junction-box cover, with well-bushed holes for the passage of the wires to the ordinary pillar terminal of the switch. All that it is necessary to do in erection, therefore, is to fix the back plate to the wall, connect the wires in the switch, which can be done away from the wall, place the cable between the bonding ring tongues and then screw the cover on to the back plate. The projection of the box on which the switch is mounted is no greater than that of an ordinary wood block. These simple operations may be compared with the work involved in fixing a switch in the ordinary manner, using a wood block. First the positions for the fixing holes in the block have to be determined, marked out and drilled. Then a similar operation has to be performed for the holding down screws for the switch, and finally two more holes have to be marked out and made for the wires to pass through the block. The wires are then pushed through, the block is fixed on to the wall, the wires put into the terminals (and if the holes for

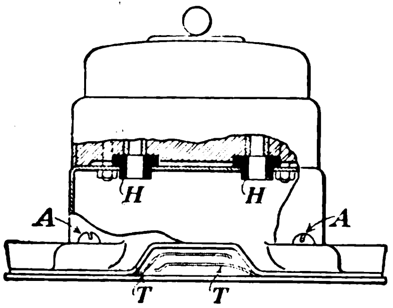


FIG. 4A.—SECTION OF SWITCH.

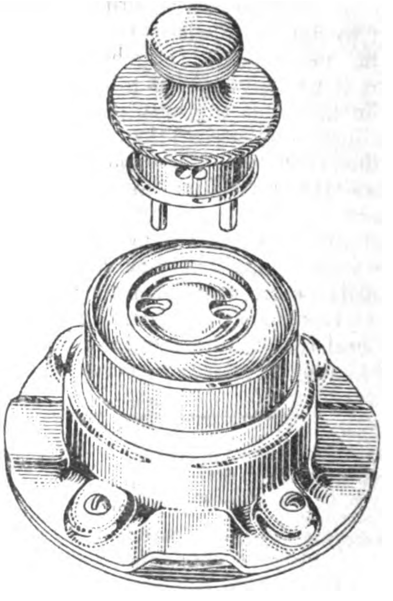


FIG. 5.—WALL PLUG AND SOCKET.

this are too large it is well known how the ends of the wires will insist on receding into the block instead of going where they are wanted), and then finally the switch has to be screwed on to the block. It would not be unreasonable to expect the saving of 10 to 15 minutes in the erection of each switch on the Glover system, and even greater saving of time in the fixing of their "pendant boxes" in place of blocks and ceiling roses. A further great advantage is that slack cable can be left inside the box and there is ample room for connecters for looping. The range of accessories includes also flange holders and wall sockets (Fig. 5) fixed direct to the boxes.

Another novelty in Glover's wiring system is the connector (Fig. 6) which takes the place of the hitherto necessary, but much abused, porcelain connector. In this the brass tube, instead of being loose, as in the porcelain connector, is firmly moulded in a strong insulating composition, and the construction is such that the head of the screw cannot project beyond the insulation, and it is impossible therefore for it to cause an earth by coming into contact with the box. In the range of fittings an alternative form of back plate (Fig. 7) is also included for back entry. This will effectively bend any number up to four twin cables, and it is particularly intended for use with pendants when the wiring is placed between the floor and the ceiling.

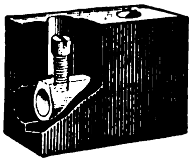


FIG. 6.—GLOVER CONNECTOR.

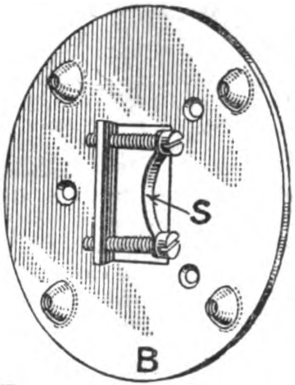


FIG. 7.—BACK PLATE FOR BACK ENTRY.

No special tools are required for erection.

The fittings as well as the junction boxes are finished in lacquered Florentine bronze, and present an elegant and handsome appearance.

One word more on the question of cost of wiring. In some districts, and with some firms particularly, the extension of lead alloy sheathed wiring systems has been retarded by the position taken up by the workmen that only about the same number of points per day can be wired as with ordinary conduit wiring. The main argument for this has been that, although there may be a few minutes saved in the actual runs, there is no time saved in fixing the accessories, and in fact, in view of the special bonding required on some systems, this may even take longer. Now the Glover wiring system meets this objection, and it appears to present a sufficient number of new features for an entire revision of ideas as to the number of points that can be wired per man per day.

Its erection is simplicity itself, and in addition inspection is greatly facilitated, for, except in the case of the back entry fittings, all bonding is on the surface and visible.

A descriptive catalogue has been issued and a useful feature in it is the inclusion of a number of diagrams which, with explanatory notes, will enable wiring circuits to be easily and quickly planned.

The new system is certain to attract considerable attention in the trade, and we most strongly advise every contractor and wireman to obtain the catalogue without delay, so as to make a careful study of it and gain an even better idea of the various points we have enumerated than can be conveyed in this article. The name of Glover has been so long and honourably associated with the cable industry of Great Britain that anything which they may place on the market may be relied on as having passed rigorous tests before being allowed to go forth to the electrical profession.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at he top left-hand corner of all letters intended for this column.

QUESTION NO. 191.

How can I convert my crystal receiving set into a one-valve set with a minimum expense?—"ASTATIC."

QUESTION NO. 192.

In the plant at our colliery, our motor load is running at .6 power factor. How can I improve this? Would it be better to improve this to unity power factor or to some value below unity?—"A. F. JAMES."

(*Replies to Questions Nos.* 191 *and* 192 *must be received not later than November* 29, 1924.)

Meetings.—A wireless section meeting of the I.E.E. will be held on Wednesday, November 5, at 6 p m., to hear an address by Mr. E. H. Shaughnessy, O.B.E., chairman of the section.

Quotations Wanted.—The Auckland, New Zealand, City Tramway Dept. are calling for tenders for the supply of one motor generator, one 30 and one 5 h.p. motor, switchboard, portable electric drill, and travelling hoist.

Glenties (Co. Donegal).—At a meeting of the Improvement Committee it was decided to proceed with a scheme for providing electric light for the town. Officials were appointed, and it was agreed to employ the services of a firm of consulting engineers to prepare a scheme and to report.

Book Announcement.—Messrs. Ernest Benn announce the second and last volume of *Electrical Measuring Instruments*, by C. V. Drysdale, D.Sc., and A. C. Jolley, A.M.I.E.E. The present volume is a continuation of the work published in Part I., extending the treatment adopted therein to the various types of direct current supply meters, induction instruments, both indicating and registering, recording instruments, frequency and phase meters, leakage indicators, indicating ohmmeters, synchroscopes, etc. The book will contain 437 illustrations and will be published early in November.

THE BENJAMIN ELECTRIC AT WEMBLEY.

The Benjamin Electric stand, situated in the Electrical Section of the Palace of Engineering, Avenue 14, Bay 15, has most probably been inspected by quite a number of our readers, but those in the provinces who have not been able to visit Wembley will be interested in a description thereof.

The stand was laid out as an up-to-date drawing office and illuminating engineering department, with draughtsmen actually at work preparing illumination schemes and technical data in connection with the company's well-known activities in this direction, thus enabling visitors who previously have had a very remote idea as to exactly what the science of illuminating engineering means to get inside information of its many ramifications and interesting details. A very short visit served to convince the most sceptical individual of the importance of correct illumination, and the careful thought and research necessary in the design and production of suitable equipment, in order to make the light source as near 100 per cent. efficient as is possible.

As might be expected, the lighting of the stand was a typical example of really good illumination, and left no doubt in the visitor's mind that the Benjamin Co. are believers in their own medicine. As a matter of fact, the most convincing proof of Benjamin efficiency is that practically 90 per cent. of the artificial illumination of the buildings in the Exhibition was carried out by Benjamin reflectors, the Palaces of Engineering and Industries, India, Ceylon, Burma, Australia, British Guiana, Nigeria and the Stadium being notable examples.

The exterior floodlighting of the main buildings was obtained from specially designed Benjamin floodlight projectors, while the bandstands, colonnades and a number of other locations, interior and exterior, utilised Benjamin lighting fittings for their artificial illumination. Of these fittings a very complete range was on view at the stand, while a fine series of actual unretouched night photographs of typical installations in practically every industry and trade, in conjunction with the technical advice available, materially assisted any factory owner or manager in his selection. Commercial lighting equipment also had its place in the exhibit, and in this connection particular mention should be made of

No. 1.—THE R.L.M. REFLECTOR,

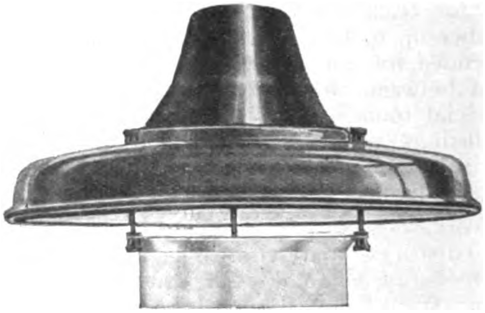
which is a general utility unit, usable in practically any industrial installation with excellent results, the contour being such that, while a widely distributed illumination is obtained, the actual light source is effectively concealed from the normal line of vision, thus avoiding objectionable glare. The company claims that it is the most effective reflector for use with the modern gasfilled lamp.

No. 2.—THE ELLIPTICAL ANGLE REFLECTOR

is the latest scientific improvement on the ordinary parabolic angle reflector, the efficiency of which is limited to certain locations only. It has been designed to give the widest possible lateral distribution of light, and is therefore particularly adapted to the illumination of signs, hoardings, posters, shop windows and certain special industrial locations, the superiority being that, in addition to a heavy flux of light directly in front of the reflector, the elliptical design provides a wide distribution horizontally, and thus builds up to a very marked degree the illumination "in between."

No. 3.—THE BENJAMIN "BIFLECTOR"

is the most recent Benjamin contribution to the cause of better lighting, and comprises a double reflector, over the lamp and surrounding it, giving an extra wide distribution of light without glare, and constituting a particularly effective fitting for industrial and commercial locations necessitating a comparatively low mounting height for units. The illumination of spinning and weaving looms, compositors' frames and similar operations has always presented some difficulties owing to the low mounting height necessary and the desirability of good illumination at many different angles with entire absence of glare. The biflector is designed to overcome these difficulties, and from its appearance it certainly appears to constitute a practical solution. The effect when alight is particularly attractive, the unit appearing to radiate a strong but gently diffused light in all directions, with entire absence of glare and apparent concealment of the lamp itself. It has 1⅛-in. hole at top for attaching to an ordinary shade-carrier lampholder, and is intended for use with gasfilled lamps up to 100 watts.



Finally, the Benjamin Co. make it their proud boast that there is a Benjamin reflector for *every* class of installation, small or large, industrial or commercial, and place the resources of their illuminating engineers at the free and entire disposal of any and everybody interested in correct lighting.

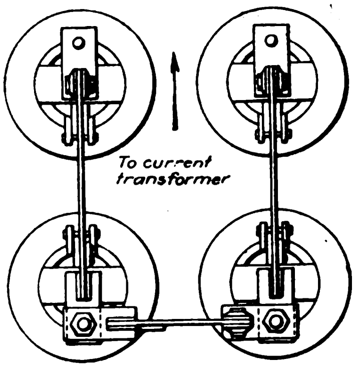
Practical Electrical Engineering Hints.

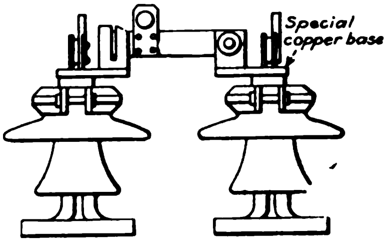
We cordially invite all our readers to contribute to this interesting and useful feature. All hints received will be given careful consideration and will be paid for at our usual rates.—The Editor.

No. 17.—How a Convenient Disconnecting Switch for Current Transformers was Constructed.

A combination of two disconnecting switches with a short horizontal blade across the upper terminals to short-circuit them makes a convenient arrangement for use with current transformers.

The arrangement which is shown in the illustration may be made up with any manufacturer's standard disconnecting switch. The smaller short-circuiting blade will require special castings to fit the standard disconnecting terminals.





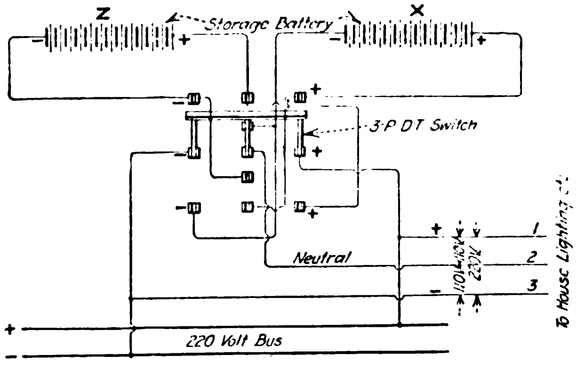
Current transformers connected through such an arrangement can be readily cut out of circuit for repairs, and meter testers can test current transformers and meters together as a unit without the necessity of waiting for silent hours when load conditions will permit interruptions to service to take equipment out of service.

The arrangement can be easily applied to circuits of any voltage, and the switches made up for indoor and outdoor use.—E. R. Jones.

No. 18.—How an Even Discharge may be Obtained on Both Halves of a Battery.

To obtain an even discharge on both halves of a battery feeding an unbalanced three-wire system, a three-pole, double-throw switch with two extra jaws on the middle blade is used. This is in use in a central station.

The battery feeds a 220-volt circuit for use in emergency to supply excitation for synchronous condensers, etc., the three-wire 220/110-volt service for house lighting and pilot lights, etc., also depends upon this battery. The load of the latter is unequally divided on each side of the neutral, this necessitating the installing of the switch so that the heavy loads may be carried alternately by different halves of the battery.

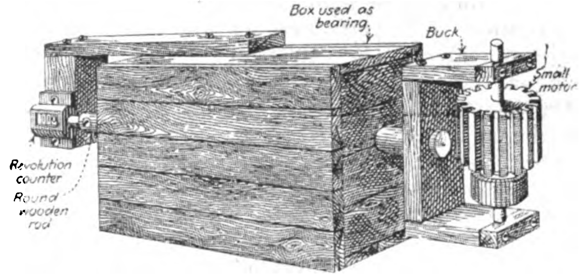


From the diagram it will be seen that the polarity of these circuits is the same for either position of the double-throw switch. In the "up" position of the switch, however, the half of the battery (X) is across 1 and 2 of the three-wire system, and in the "down" position it is across 2 and 3. By reversing this switch once each day it is possible to obtain a perfectly even discharge of the whole battery.—E. C. Soares.

No. 19.—How a Quick Arrangement may be Made for Winding a Small Armature.

To make an accurate and rapid rewinding of a small armature the method shown in the sketch was adopted. The armature was mounted in a small horse of the same model as the larger ones in use in the winding shop. A broom handle was then fitted in a hole bored in the centre of the base.

In each end of a suitable box a hole was bored of sufficient size to just take the broom handle as a snug fit. A "rev." counter, direct connected, was attached to the back of the broom handle, thus completing the apparatus.



The armature was revolved with the right hand, while the left hand guided the wire into the slots. The rev. counter recorded the number of turns and allowed the winder to concentrate upon the operation of placing the wire in the slots. The job referred to here was completed in less than two-thirds of the time required for the job under ordinary conditions.—Frank Soete.

A HUNDRED YEARS OF ELECTRICAL ENGINEERING.*

(Concluded from page 583.)

Turning to another branch of electrical communication, it is no exaggeration to say that modern business life has been revolutionised by the telephone, which will shortly celebrate its jubilee, for it was in 1876 that Graham Bell invented the magnetic telephone receiver, although others, notably Reis, had been working at the problem since 1861. Bell showed his telephone in operation at the Philadelphia Centennial Exhibition in 1876, and Kelvin, who was one of the judges, brought one back with him and demonstrated it to Section A of the British Association, at its meeting in Glasgow in the autumn of 1876.

A successful telephone system requires much more than efficient transmitters and receivers, and the great development which has taken place has been largely a matter of improvement in the design of the many elements that go to make up a telephone exchange. The modern manual central-battery exchange, in which one has only to lift his receiver to call the operator and be connected in a few seconds to any one of 10,000 other subscribers, is a marvel of ingenuity and construction. But this is now gradually being replaced by the greater marvel of the automatic system, in which the operator is eliminated and the subscriber automatically makes his own connection to the desired subscriber. Attention should be drawn to two outstanding inventions in the actual transmission of telephony over long distances, viz., loading and repeaters. It was Oliver Heaviside who in 1885 proposed to improve the range by increasing the inductance of the line. Although this revolutionary suggestion fell on deaf ears for fifteen years, it ultimately proved to be one of the great inventions of telephony; it is of special importance in underground and submarine telephone cables, the electrostatic capacity of which otherwise seriously limits the range. The other outstanding novelty is the introduction of repeaters at intermediate points in long telephone lines. These repeaters are specialised types of low-frequency amplifiers; they were made commercially possible by the invention and perfection of the three-electrode thermionic valve. The attenuated speech currents arriving at the end of a section of line are amplified and thus given a new lease of life before being passed on to the new section. By using a large number of such repeating stations, telephonic communication has been established between New York and San Francisco. But in addition to making such long-distance communication possible, the use of repeaters enables medium distances to be bridged by relatively cheap lines of high attenuation.

One important application of telephony which is not generally known is in the control of transport; the advantage to be gained by controlling the whole railway traffic of a large district from a central office need only be mentioned to be appreciated.

Turning now to radio telegraphy and telephony, one cannot but marvel at the rapidity of its development and the inroad that it has made during the last two or three years on the domestic life of the whole civilised world. The theory of Clerk Maxwell in 1864 and the laboratory experiments of Hertz in 1888 found their first practical application in Marconi's Italian experiments in 1895 and his demonstrations in England during the following year. Much of the rapid progress was due to his perseverance, vision, and courage in perfecting apparatus for short-distance work, and simultaneously experimenting over long distances, and thus, in the year 1901, settling by actual demonstration across the Atlantic the vexed question as to whether the waves would pass around the earth over distances of several thousand kilometres or go off into space.

The accomplishment of long-distance communication bristled with difficulties, largely due to unsuspected atmospheric effects which are still little understood; but such progress has been made, and is continually being made, that one dare not now adopt an incredulous attitude to the wildest dreams or forecasts of what is to be accomplished by "wireless." The commonplace facts of to-day would have appeared beyond the bounds of possibility ten or twenty years ago.

I have attempted to trace, in a necessarily somewhat superficial, but, I trust, none the less interesting, manner the development during the last hundred years of some of the principal applications of electricity to the service of mankind. In preparing this address, I have been greatly impressed by the enormous advances made, especially during the last thirty or forty years, in the mastery of man over the resources of Nature, and in the use of these resources to the amelioration of the conditions of life. By the aid of electricity the energy of the coal or of the lake or river a hundred, or even two hundred, miles away is transmitted noiselessly and invisibly to the city, to supply light and warmth, to cook the food, to drive the machinery, to operate the street cars and railways.

By its aid one can flash intelligence to the most distant part of the globe, hold conversations with friends hundreds, or even thousands, of miles away, or sit in one's home and listen to music and lectures broadcast for the entertainment or instruction of all who care to equip themselves with what may almost be regarded as a new sense. Whereas, thirty years ago, a ship at sea was completely isolated from the life and thought of the world, it is now in continuous communication with the land and with every other ship within a wide range.

In no branch of electrical engineering, however, is there any suggestion of having reached finality; on the contrary, rapid development is taking place in every direction, and we can look forward with confidence to an ever-increasing application of electricity to the utilisation and distribution of the natural sources of energy for the benefit of mankind.

---

* Address before the British Association, at Toronto, by Professor G. W. O. Howe, D.Sc., President of Section G.—Engineering.

Two publications have just recently been issued by **Messrs. Sterns, Ltd.**, of Royal London House, Finsbury Square, London, E.C.2. They deal respectively with "The Lubrication of Steam Turbines, with Notes on the Determinants of Correct Lubricants," and "Lubrication of Diesel and Other Types of Heavy-Oil Engines." Both are calculated to interest quite a large number of the readers of this paper who are in charge of steam turbines and Diesel engines, and we can therefore recommend early application for copies. Messrs. Sterns, Ltd., are prepared to send either or both post free to any responsible reader who mentions this notice.

Since seventy-five

In those days Charlton was little more than a riverside village. In those days the J. & P. Organisation was in the "acorn stage." In those days the utilisation of Electricity for commercial purposes had really only just begun . . . . In truth, these fifty years have made a difference ! . . . . To-day Charlton is one of the largest riverside manufacturing centres — the J. & P. Organisation — makers of

Cables for all Services

has ramifications in practically every country in the world—the J. & P. works have grown beyond recognition, and the uses of Electricity have multiplied many, many times.

And so have we grown together, and coincident with the growth of electrical development—so have we acquired an invaluable experience in manufacture, and to-day, offer all the advantages of the specialised knowledge, which has naturally accrued, to our customers in every corner of the world. We invite your next Cable enquiry.

Johnson & Phillips, Ltd.,

Specialists in the Transmission, Transformation and Control of Electricity,

Charlton,
London, S.E.7.

City Office and Stores:
12, Union Court, Old
Broad Street,
E.C.2.

For Electrical Engineers & Electricians

DICTIONARY OF ELECTRICAL TERMS.

By S. R. ROGET. Up to the present no complete Electrical Dictionary has been compiled. The present book, which includes practically every electrical term (including those used in wireless telegraphy), will be of interest to every member of the electrical engineering profession. 7s. 6d. net.

ELECTRICAL TECHNOLOGY.

By H. COTTON, M.B.E., M.Sc., Senior Lecturer in Electrical Engineering of the Nottingham University. The second volume of the Engineering Degree Series. Written specially for students studying for the Engineering Degree, either the B.Sc., Engineering, or the A.M.I.E.E. The book is also suitable for students who are taking the National Certificate Examination in Electrical Engineering. 12s. 6d. net.

RAILWAY ELECTRIFICATION.

By H. F. TREWMAN, M.A., A.M.I.E.E. A complete survey of the economics of the different systems of Railway Electrification from the engineering and financial points of view. This book is of special interest at the present time when systems of Railway Electrification are in active progress. There is at present no other up-to-date work which deals with both the financial and engineering sides of the subject. 25s. net.

ELECTRIC LIGHTING & POWER DISTRIBUTION.

By W. PERREN MAYCOCK, M.I.E.E. An elementary manual of Electrical Engineering for students preparing for the examinations of the City and Guilds of London Institute. In two volumes. Vol. I., Eighth Edition, 10s. 6d. net. Vol. II., New Edition, thoroughly revised and enlarged, by C. H. Yeaman, M.I.E.E., 10s. 6d. net.

POWER STATION EFFICIENCY CONTROL.

By JOHN BRUCE, A.M.I.E.E. This book is intended chiefly for power station engineers, consulting engineers, and students of electrical engineering. It contains a résumé of modern methods of controlling the efficiency of electrical generating plant on the steam and electrical sides. By its use the power station engineer will be assisted in obtaining the most economical performance from the plant under his control. 12/6 net.

D.C. DYNAMO AND MOTOR FAULTS.

By R. M. ARCHER, B.Sc. (Hons.), A.R.C.S., M.I.E.E. An elementary work dealing with the causes, symptoms, diagnosis and treatment of the faults and troubles commonly experienced in the operation of D.C. Dynamos and Motors. For students, central station engineers, and those in charge of electrical installations. 7/6 net.

THE ELECTROLYTIC RECTIFIER.

By N. A. DE BRUYNE. A useful survey of present-day theory and practice for electrical engineers, physicists, and wireless amateurs. Explains how to make and use a rectifier for charging accumulators from alternating current supply mains. With 23 illustrations. 3/6 net.

RADIO COMMUNICATION.

By J. H. REYNER, B.Sc. (Hons.), A.C.G.I., D.I.C., of the Post Office Engineering Department. A manual of modern theory and practice, covering the syllabus of the City and Guilds Examination and suitable for candidates for the P.M.G. Certificate. 121 illustrations. 5/- net.

OF ALL BOOKSELLERS.

Full Particulars post free from—

PITMAN'S, PARKER STREET, KINGSWAY, W.C.2.

Various Items.

Chile.—Tenders for electric generators, etc., required in connection with the construction of the Port of Constitucion are asked for. Particulars from the D.O.T., 35, Old Queen Street, London, S.W.1, quoting A.X. 1,409.

Meetings.—The I.E.E. will meet on Thursday, Nov. 6, at 6 p.m., when a demonstration of "An Electric Harmonic Analyser" will be given by Messrs. J. D. Cockcroft, R. T. Coe, J. A. Tyacke, and Prof. Miles Walker, D.Sc.

Electric Cooking Equipment Contract.—The G.E. Co., Ltd., has received an order for an electrical cooking equipment for the Bucks County Mental Hospital at Stone, near Aylesbury. The apparatus will cater for about 1,000 persons, and will comprise a "Magnet" four-oven range, stock pots, egg boiler, boiling table, fish range, grill, baking ovens, and hot-cupboards. The only non-electrical items are the existing steamers, boilers for tea, vegetables and soup, which will be steam heated.

Modern Ships Wireless.—The s.s. *Geraldine Mary,* which is being built at Barrow, as an addition to a fleet which carries paper from Newfoundland to this country, is to be equipped with the latest type of wireless apparatus by the Marconi International Marine Communication Co., Ltd. The vessel will be remarkable for her installation, not only because her transmitting apparatus will be of higher power than that usually fitted to cargo boats, but also because she is to carry the most modern devices for safety at sea, including Marconi direction finding equipment and lifeboat wireless apparatus.

Change of Title.—The Stearn Electric Company, Ltd., of 12, Grosvenor Gardens, S.W.1, has been formed to acquire the Stearn Electric Lamp Company, Ltd., and has taken over all the latter's assets and liabilities. The change has been made with a view to increasing the scope of its activities, and whereas the old company supplied Association lamps only, the new company will also supply cables and other electrical goods. Sir Maxwell Hicks, C.B.E., is the chairman of the new company, the remaining directors being Messrs. G. M. Bottome, J. E. Edgecombe (formerly borough electrical engineer, Kingston-on-Thames), and L. J. Yeoman.

Wireless Telephones in Greece.—Wireless telephony has been seized upon as a valuable aid to the conduct of business by a number of firms in Greece, where the regulations permit of the private use of this means of communication. Four are already equipping their premises with the Marconi "Popular" wireless telephone set (type XP), to link up their head offices in Athens with their branch offices in the Piræus, and further inquiries for similar sets have been received from other firms. This type of wireless telephone set has been designed for use by people possessing no technical knowledge, and is as easy to operate as the ordinary post-office telephone.

Liquid Fuels for Oil Engines.—In consequence of the difficulties experienced in connection with the provision of sufficient financial support, it has been decided not to proceed any further in the matter of the Provisional Committee of the British Research Association for Liquid Fuels for Oil Engines, and they propose, therefore, that after payment of all liabilities and expenses the remaining balance of funds, amounting to about £60, be paid over to the Diesel Engine Users' Association, to assist in any research work on fuel oils or lubricating oils for use with heavy-oil engines, or in giving prizes for papers on suitable subjects to be read before the Association. The proposal has been accepted with thanks by the members of the D.E.U.A.

The Diesel Engine Users' Association.—The next meeting of this Association is to be held on Friday, November 14, at the Engineers' Club, Coventry Street, W.1. The Committee have prepared for discussion a further report on the subject of "Heavy-Oil Engine Working Costs," dealing with particulars of actual working costs of heavy-oil engine plant during the year 1923-24, which have been collected from members. In view of the widespread interest which has been taken in the Committee's previous reports on this subject, it was decided some time ago to issue such reports annually, and the present report forms the third of the series. Non-members interested in the subject and desirous of attending the meeting can make application for tickets of admission and advance copies of the report to Mr. Percy Still, Joint Hon. Sec., at 19, Cadogan Gardens, London, S.W.3.

A parlour Socialist would be all right if he never were permitted to leave the parlour.

Trade Notes.

List K, which has just been issued by **Eck and Brook, Ltd.**, of 4, Palmer St., Westminster, London, S.W.1, gives illustrations and details of the latest types of Hartmann and Braun measuring instruments for wireless telephony. Messrs. Hartmann and Braun have been celebrated for very many years as makers of measuring instruments of the very highest class, and the list therefore is nearly certain to prove of interest to wireless dealers who have inquiries for instruments of this description. It will willingly be sent on receipt of trade application.

Making Your Window Work Overtime is the title of a circular dealing with successful shop-window lighting which is now being issued by the **B.T.-H. Co.**, of Mazda House. It illustrates a shop-window flood light, a spot light projector, and the "Rurolux" shop tray, all of which are eminently suitable for illuminating shop windows and advertising goods generally after closing time. The circular is arranged for over-printing with the name of the local contractor to whom it may be supplied, and it should therefore be an excellent medium for inducing clients to extend their installations during the coming season.

A series of illustrated lists has just been issued by **Messrs. J. H. Heathman**, the well-known makers of ladders and trestles, of Parson's Green, S.W.6. The lists are of direct interest to all contractors, and should therefore be written for without delay.

Leaflets 240 and 245, which have been issued by **Crompton and Co**., of Chelmsford, describe their house-lighting and semi-automatic iron-clad switchboards respectively. They are well illustrated and should be of direct interest to installation contractors throughout the country who specialise in this class of work.

Two leaflets, numbered 341/10-1A and 341/8-1, have just been issued by the **Metropolitan-Vickers Electrical Co., Ltd.** The first describes their new type "P.B." Relay, which can be definitely adjusted for a minimum time characteristic, and can be depended on to work selectively. The second describes their type "F.B." Super Sensitive Instantaneous Relay, which they believe to be the most sensitive relay for power purposes on the market. They are generally adjusted to trip with 100 milli amps., but they can be arranged to trip with certainty down to 50 milli amps. Full details respecting the construction and design of both these relays are given in the publications named, also some details respecting the various applications for which they are suited. They also issue Descriptive Leaflet No. 405/3-1, giving details of the operation of their system of supervisory control. Some means of supervisory control from a central point is now becoming necessary in large systems, and fifty of these have already been installed throughout the world and are working successfully.

BRITISH MICA Co., Ltd.
(Contractors to H.M. Government.)
ELECTRICAL INSULATING MATERIAL MANUFACTURERS
15, Cardington Road, Bedford.

MICA, COMMUTATOR SEGMENTS, MICANITE SHEETS, TUBES, RINGS, WASHERS, MICA POWDER, FIBRE, PRESSPAHN AND INSULATING, PAPERS, CLOTHS, TAPES, &c. MICA IMPORTERS

Sample Pair Sent on Approval for 8/6.
Made of Pure Para Rubber, soft and durable and unaffected by climatic conditions
DAVID MOSELEY & SONS, Limited,
ARDWICK, MANCHESTER.
MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL

ELECTRICITY

PRACTICAL TRADE JOURNAL

NOVEMBER 7, 1924.

CONTENTS.

	PAGE
Now the "Chief" is Unemployed	601
The History of Hackney Street Lighting	602
Our Wireless Corner	603
The "Murray" Water-Cooled Furnace Wall	604
A Unique method of Floodlighting	604
Current Topics	607
Electrical Engineering—Grade I.	609
Electrical Machinery Exports	609
Electric Passenger Lifts	610
New Designs in G.E.C. Home Office Pattern Shielded Lampholders	613
The Inter-Connection of Power Stations	614
Charles Orme Bastian	616

NOW THE "CHIEF" IS UNEMPLOYED.

There was a time, not very long ago, when the man who is now upon the shelf was glorying in activity—when he met responsibility with a smiling face and laboured to improve the efficiency of the department under his control. He was a person of importance—the manager called him "Mr. Blank" and the men under him called him the "Chief" or the "Boss." To-day, his glory has departed; at home he has leisure to reflect, and peradventure many of his ertswhile actions will be mentally reviewed in the light of other circumstances.

For he is now unemployed—the seemingly impossible has become possible. How often has he, journeying to business in the morning, given a casual glance to the crowd of unemployed besieging the local Labour Exchange, and how often has he referred contemptuously to "the dole"? And then he would turn again to his morning paper, becoming immersed in the sporting or political reports, but carefully avoiding any reference to the "plight of the unemployed."

He was not directly concerned. He endeavoured to avoid any individual at the work gates who sought to accost him, for he was not requiring additional labour. He was not hardhearted, and no doubt muttered "Poor devil" under his breath, but he was powerless to do anything. The letters which reached him from people desiring employment were just glanced at and consigned to the waste-paper basket, and with this action the matter was dismissed from the mind, for he had more important problems to consider.

To-day, by a turn of the wheel, *he* is unemployed, due to the closing of the factory, or the disbanding of his department, or a general reduction of staff consequent upon bad trade. He, who had considered himself indispensable—whose faith in his own capabilities had imbued him with a sense of superiority over the general run of workers, is informed that the firm has no further use for his services. And now he has time for reflection!

"What has gone wrong, and how have I contributed to this state of affairs?" This is exercising the mind of the unemployed department manager as he sits in melancholy comfort by his own fireside, and the questions are not easy to answer—satisfactorily, at all events. So far as he knows, he has always done his duty, taken a pride in his work, and done everything to make his department efficient. He could understand dismissal on account of incompetency or misconduct, but these charges have not been brought against him. His department has been disbanded "by order of the directors," for economic reasons, but surely there could be a place found for him in another part of the factory.

This is, of course, the personal view, but what caused the disbanding of that department? No trade—the product not needed, and consequently a slackening off in manufacture. Yet the commodity *is* needed, and should command a good sale, but—the price is too high. The 1¼ millions of unemployed have little to spend, and that little is swallowed up in real necessaries. A further 2 millions are either working short time or are submitting to wage reductions, and they, too, are spending sparingly.

For the first time, perhaps, the real significance of the question is apparent to the unemployed manager, for by taking his own case he can demonstrate. Instead of paying 30s. a week to his grocer, he now exists upon what can be purchased for 15s. The grocer has many similar cases upon his books, and he also must economise. He orders fewer supplies from the wholesalers, who in turn order less from the manufacturers, and in each instance someone is thrown out of employment. And, if this is the position in regard to foodstuffs, which are necessaries, it is intensified in the case of other commodities, which, although desirable, are not absolutely necessary.

As an employed individual the department manager's range of vision is somewhat restricted, and it is to be feared that, until he has personal experience of unemployment, he will not be particularly interested in the broad issue. When he is "on the shelf" he is likely to change his opinions. He is no longer sure that his ideas are good (he thought himself indispensable until it was proved otherwise), and it may be that, when he returns to active life, his methods and ideas will have undergone a complete change.

No longer will he be merely loyal and submissive, concerned only with the interests of his employers, but he will concern himself also with the interests of his fellows. He will have realised that he has assisted, by his selfish policy, in bringing about the present-day state of affairs, for the department manager is a selfish individual, and his one aim and object is to achieve personal success by means of what he terms economy. He would not pay a man £4 a week if he could get him for £3, even if he were well worth the former wage, and he considers this common-sense policy.

But is it? Does that man give a £4 return for a £3 wage? It is hardly likely, but it is possible. Suppose that he does, what happens? After a time he asks for an increase, but the manager is not disposed to agree. "I will do my best, but the directors are hard to convince." As a matter of fact, the manager has the power to grant an increase without reference to the directors; but it suits him to pretend otherwise. So the man is informed that the directors will not just now sanction an increase, but he (the manager) will see that the matter is not forgotten.

The man must be satisfied with this, but his heart is not in his work, and, subconsciously perhaps, he adopts a "go-slow" attitude. He knows that he is underpaid, and he resents it. Is it surprising that his efficiency is impaired? And yet factories are closing down, or reducing their staffs, because costs are too high. Surely the unemployed manager will, upon reflection, realise to what extent he has contributed.

It is, perhaps, no bad thing that he has been drawn into the vortex, for he will learn more of economics during three or four weeks of enforced inactivity than in as many years of constant employment. He will see that he has a duty to perform to those who are subservient to him, and that it is in performing that duty that he furthers his employers' interests. He will realise that his own well-being, and that of his employers, is bound up in the well-being of the general mass of workers, who must be given opportunity before they can extend their capabilities.

He will "see himself as others see him," a workman and a servant of the firm, even though he is to all intents and purposes an employer—and he will have a truer sense of the value of others, and how they must be treated. He will become a better manager and a better business man, because he will have realised that "value for money" is no mere slogan, but an indisputable truth, whether applied to the commodity produced or to the labour which produces it.

THE HISTORY OF HACKNEY STREET LIGHTING.

In the good old days things were different; to-day we seem to think only of cheapness and a lower rate, rather than in terms of value of service rendered for a certain cost.

Turning to an extract from the report of the Hackney Board of Works in 1857, we find that the Imperial Gas Company supplied gas to 1,106 lamps at £5 per lamp per annum, while Mr. Cassell supplied 34 naphtha lamps at £4 10s. per lamp per annum. Evidently the better, though dearer method was coming on top.

In 1858 the Board reported that: "During the past year the Imperial Gas Company have lighted a part of the parish of Stoke Newington, near the Green Lanes, which had been previously lighted with naphtha, an uncertain and inefficient mode of lighting which the Board are desirous of superseding as soon as may be, but which they are at present compelled to adopt in some parts of the parish in consequence of the impossibility of enforcing on the gas company the expense of laying down the gas mains where there are no other than public lights."

Since this time Hackney has passed through the era of the fish-tail gas burner, which gave very little light; through the era of the upright gas mantle and the era of the inverted gas mantle, which burns the reflector of the lantern brown, and is so subject to draught that in stormy weather one often sees a little blue flame instead of an incandescent mantle.

In the most important main streets electricity came into its own about 1901; then the secondary main streets were lighted with flame arc lamps. Immediately after the war all the arc lamps were scrapped, and gasfilled lamps with special globes for scientifically distributing the light were substituted.

At last, and not until it could be proved that electricity would give 55 per cent. more light for less cost, electricity is going to supersede gas for the lighting of the whole of the remaining streets in the borough.

It is interesting to contrast the statement in the Hackney Board of Works report for 1858, where it is said that it was necessary to use some naphtha lamps because "of the impossibility of enforcing on the gas company the expense of laying down gas mains where there are no other than public lights," with the position to-day, when it is known to be of definite commercial value to lay 62 miles of new electrical distributing mains in Hackney, so that the whole of the street lighting can be converted from gas to electricity.

This scheme now being put in hand consists of the changing over of about 3,128 lamp-posts from inverted incandescent mantle gas lamps, consuming 3¼ cubic feet of gas per hour, to gasfilled lamps, consuming 75 watts.

The existing posts and lanterns will be used. Reflectors which have been corroded and burnt up by the heat and fumes from the gas burners are to be replaced, and the new reflectors will be specially fitted with a carrier ring to support a Holophane refracting band, which surrounds the filament of the lamp and secures the most economic distribution of the light.

The old method of hand lighting will be superseded by the provision of Horstmann 30-day time clock switches, fitted in special cast-iron boxes, which connect the lanterns to the lamp-posts, which have been specially designed by Mr. J. R. J. Bowden, the deputy electrical engineer to the borough.

It is estimated that the additional electrical distributing mains required will cost £145,000, that the lamp services will cost £18,768, while the lamp-post equipment will cost £13,350.

It is anticipated that the Unemployment Grants Committee subsidy will be applicable so far as 70 per cent. of the total expenditure is concerned, and under these conditions during the first five years the saving due to the electrification will be £1,161 per annum, during the next five years £400 per annum. After that period the whole of the loan charges on lamp-post equipment will have vanished. The saving will then be £2,073 per annum during the next 2½ years, and then up to the 25th year the saving will be £1,500 per annum. After that time all loans will have been paid off, and the annual saving will be no less than £2,758.

If there were no subsidy, the cost of the new lighting would exceed the present cost by only £173 9s. 2d. per annum, but the light would be increased by no less than 55 per cent.

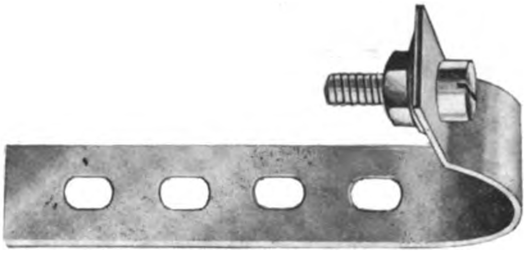
Messrs. F. and E. Stoneham, Ltd., the well-known booksellers, of 79, Cheapside, E.C.2, have recently issued a classified guide to the literature relating to the engineering and mechanical industries published between August 1, 1923, and July 31, 1924. The information contained therein is neatly set out under the various headings, and should, therefore, appeal to readers who wish to know the titles of books dealing with the special subjects in which they are more directly interested. A copy will be willingly sent to any reader on application.

An attractively printed leaflet has been issued illustrating and describing the various types of "Xcel" electric fires which are now being marketed by the **Automatic Telephone Mfg. Co., Ltd.**, of Milton Road, Edge Lane, Liverpool, and will willingly be sent to any trade reader or electrical contractor on application. It contains details of several new types which have this season been introduced to the well-known "Xcel" family, and can be cordially recommended to our readers.

Our Wireless Corner.

A NEW EARTH CLIP.

A good earth is an essential for the satisfactory operation of any radio receiver, and in general practice a main water-pipe affords the best possible earth connection for the amateur. Even a water-pipe may not give the best results as an earth unless the earth wire is correctly attached to it in such a way as to give a good firm electrical joint. While a soldered connection must be acknowledged to be the best, such a connection is not possible to the average amateur, as with ordinary soldering kit the attachment of a wire or wires to a cold water-filled pipe is a difficult task. The simplest way out of the difficulty is to use an earthing clip specially designed for the job. There are a number of such devices on the market, and, while some are simple, some fall short of the ideal as they are not simple enough.



The clip that we illustrate herewith is sold by Messrs. Frank Kent and Co., electrical engineers, Carlton House, Regent Street. Its outstanding features are that it is simple, it is made from soft rolled copper strip, and is therefore easy to bend into position, and hugs even an irregular pipe with a good tight contact. It is, of course, essential that the pipe is thoroughly clean or scraped bright before the clip is fitted.

The standard clip may be attached to ½ in., ⅝ in., ¾ in. and 1 in. pipes, but the company make a number of other sizes, and even an additional type of somewhat simpler construction. This, however, is made in a range of sizes each of which fit one size of pipe only. For the average dealer, therefore, the type we illustrate herewith is no doubt the best and fills all normal requirements. Messrs. Frank Kent and Co. will be pleased to send particulars and prices to all interested.

GECOPHONE PRICE LISTS.

Up-to-date prices and full details of "Gecophone" wireless receiving sets, loud-speakers and amplifiers, and "Gecophone" wireless components, are contained in three attractive little octavo booklets, issued by the General Electric Co., Ltd., and numbered respectively BC.2425, BC.3437 and BC.3413. On glancing through the pages of these booklets we notice that in addition to the well-known "Gecophone" crystal set No. 1 and the two-valve receiving set employing one high-frequency and one detector valve, and other familiar Gecophone models, an entirely new range comprising one-valve, two-valve and three-valve sets have been produced for this season's trade.

The single-valve set has the conventional reaction circuit, aerial tuning being effected by a variable condenser in parallel with a fixed inductance coil. A vernier condenser is provided for fine tuning, and all connections are made by means of plugs and sockets at the back of the case.

The two-valve set comprising detector and one stage of low-frequency amplification has tuning arrangements similar to the first model, but it is supplied in two forms, one a flat model, and the other a handsome cabinet instrument with a lower compartment to contain the high-tension battery.

The three-valve model comprises detector and two stages of low-frequency amplification, and is supplied either with vertical panel, as in the one-valve set, or as a cabinet-de-luxe with double folding doors and a drawer beneath for the high-tension battery.

Special mention should also be given to the single-stage and two-stage low-frequency amplifiers, which are of most compact design and beautifully finished. The transformers used in these amplifiers are of special design, the result of careful and thorough investigation of the causes of distortion and the methods of eliminating it. They are carefully calculated to avoid all distortion effects.

The "Gecophone" Model "A" loud-speaker is an efficient instrument of very pleasing proportions offered at a popular price, while the range of components is most exhaustive, and as every item conforms to the "Gecophone" standard of excellence, and is identical with the components used in the manufacture of standard sets, it will be appreciated that they are apparatus of the very highest quality.

The booklets mentioned are now available for distribution, and trade readers should hasten to obtain their copies, additional supplies of which are supplied overprinted with dealers' names and addresses, being obtainable on application at Magnet House, Kingsway, or any of the company's provincial branches.

PROMPT MEDICAL AID.

Two more instances of the use of wireless in securing medical treatment for sailors at sea have been reported. The s.s. *Airway*, bound from Newport, Mon., to La Plata, on September 25 informed the *Desna* by wireless that an apprentice was dangerously ill. The *Desna* accordingly changed her course, and, when the vessels met, her doctor went aboard the *Airway* and found the patient was suffering from double pneumonia. Medical facilities on the *Airway* being inadequate, the patient was transferred to the *Desna*, where he made rapid strides towards recovery, and on arrival at Liverpool was transferred to hospital. There is no doubt that the boy's life was saved by wireless. In the second case, during the recent voyage of the s.s. *Hollypark*, the bos'n fell 14 ft. down a hold, and it was feared that he had received internal injuries. A general wireless call for medical assistance was sent out, and was answered by H.M.S. *Valerian* and by an American coast station. Detailed medical instructions were given, and were carried out until the ship reached port, when the man was conveyed to hospital, and was soon on the road to recovery.

MEETINGS TO BE HELD.

The members of the Institute of Engineering Inspection will meet at the Royal Society of Arts, John Street, Adelphi, at 5.30 p.m., on Thursday, November 13, when a paper on "The Development of Long and Short Wave Wireless Signalling" will be read by Mr. A. P. Welch. It will be illustrated by lantern slides, and an advance copy of the paper will be available on application a few days before the meeting.

THE "MURRAY" WATER-COOLED FURNACE WALL.

An entirely new and highly ingenious contrivance has now appeared, the "Murray" water-cooled furnace wall, for improving the efficiency of water-tube boilers, primarily in connection with the operation of mechanical stokers. It consists essentially in constructing the two side walls of the combustion chamber of a series of vertical 4 in. steel tubes, close together, through which the boiler feed-water circulates, entering through the headers at the bottom and being discharged through the corresponding headers at the top direct into the boiler. It is claimed that this gives an enormous increase in the net heating surface of the boiler plant efficiency with mechanical stoking, an achievement equal to that of pulverised fuel on the latest principles.

The 4 in. tubes are of solid drawn steel, placed side by side at 7 in. centres, and both sides of the tubes are provided with welded ¼ in. steel flanges or fins, one of which is 1¾ in. wide and the other 2¾ in. from the tube surface. These fins overlap one behind the other, a long and a short one always being in contact, so that the entire surface wall is built up of 4 in. water-cooled steel tubes with 3 in. of flat overlapping steel plates between. Behind this tube wall there is built another wall 2½ in. thick of firebrick, together with 2½ in. thick of some insulating material, which is in contact with the outer casing of the boiler plant, the intention being merely to prevent air leakage. Thus the temperature after passing through the steel tube wall does not exceed 400 deg. F., whereas in the combustion chamber it is something like 2,500 to 2,800 deg. F.

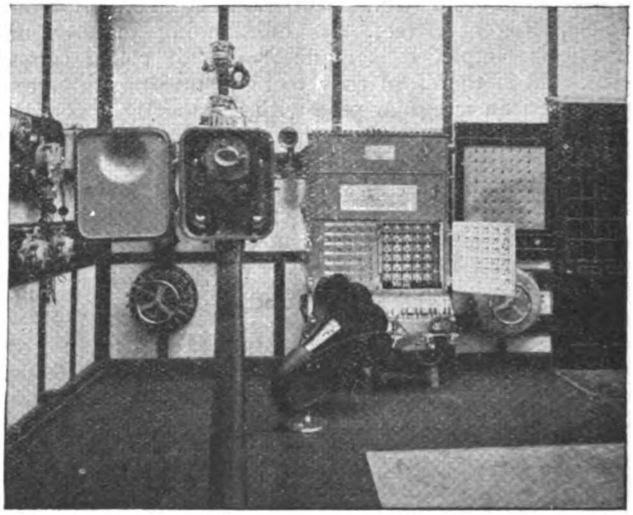
The great advantage of the "Murray" tube from the point of view of increasing the boiler-plant efficiency is the improved radiant heat transmission. It is well known that in most types of water-tube boilers the bottom two or three rows of tubes do nearly all the work, because of the high efficiency of radiant heat, the tubes above these being only heated by conduction and conversion, so that they contribute very little to the evaporation. The net result of the "Murray" tubes is to increase the heat transmission to an extraordinary degree—equal, in fact, to very nearly twice that of most existing boiler tubes.

As typical of the results being obtained, it may be stated that one series of tests showed no less than 92.7 per cent. boiler plant efficiency with multiple retort stokers, whilst the very high rating can be obtained of 11 lb. of water from and at 212 deg. F. per square foot of heating surface per hour. In the case of two very large water-tube boilers, each having a normal evaporation of something like 150,000 lb. of water per hour, one of these fitted with "Murray" tubes had a temperature in the escaping flue gases from the boiler of 150 deg. F. less than the other, and it is estimated that the actual performance of the tubes was equal to about 60 to 80 lb. of water evaporated per square foot of heating surface per hour. In one case the boiler was actually forced to 18.2 lb. water from and at 212 deg. F. per square foot of heating surface, more than twice the usual maximum evaporation with mechanical stoking, and a further advantage claimed for the tubes is that they reduce the wear and tear on the brickwork setting at the back, since the radiant heat is absorbed so quickly. Also it is stated that no sign of damage is ascertainable after eight months' hard running, and the struggle between mechanical stoking and pulverised fuel promises to be keener than ever. The European patent rights are, we understand, controlled by the Underfeed Stoker Co., Ltd., of London.

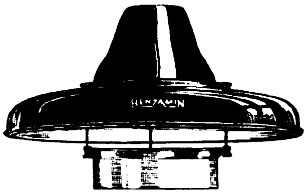
A UNIQUE METHOD OF FLOODLIGHTING.

The general lighting arrangements in the Palace of Engineering at the British Empire Exhibition may be quite suitable to allow visitors to see clearly up and down the various avenues, but we know from actual experience that local lighting on stands and in pavilions is necessary if the exhibits are to be easily inspected. In some cases difficult problems exist as to the best method of illumination, the nature of the exhibits varying so widely that a system of lighting for one stand may not be suitable for another. For instance, some exhibits require to be inspected in the horizontal position, others in the vertical position, and so on.

An ingenious arrangement for illuminating their vertical exhibits was adopted by Alfred Graham and Co., who occupied the stand opposite the main entrance to the G.E.C. pavilion. From our illustration it will be seen that considerable difficulty would be experienced in lighting by ordinary means, say, the interior of the vertical Navyphone exchange switchboard, shown in position behind the loud-speaker upon the floor of the stand. The method adopted, therefore, was a system of floodlighting from concealed sources, a G.E.C. floodlight projector fitted with a 500-watt projector type Osram lamp being concealed in the loud-speaker horn. The result of this combination was that light was projected into the equipment, which could be easily inspected by visitors who might be standing in comparative semi-darkness.



Brilliant Light Without Glare
The BENJAMIN BIFLECTOR



The latest contribution to scientific illumination.

Ideal for Spinning Frames, Weaving Looms, Compositors' Frames, Offices, Schoolrooms, Hospitals, etc., etc.

Advt. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited, and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL & CO., LTD., 36–39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

British Contracts for British Firms.

Two outstanding contracts for important electrical plant decided during the past week have been allocated respectively to a home manufacturer and a firm in Switzerland. The patriotic decision must be credited to Stockport Town Council, on a recommendation from the Electricity Committee, although the decision was apparently criticised by certain councillors, in the form of a proposed amendment to refer the matter back for reconsideration. The English tender, amounting to £34,385, was for a 12,000 kw. turbo-alternator, whereas the Swiss tender for an equivalent plant was £26,850, approximately £7,000 less. In discussing the recommendation, Councillor Nixon voiced the opinion that if foreign competition were disallowed the prices of English manufacturers would be exorbitant. Sir Thomas Rowbotham stated that this was an exporting country, and if we did not allow foreign goods to come in, other countries would take up a similar attitude and we should be doomed.

Councillor T. W. Potts seems to have been the only speaker to hit the nail on the head and draw attention to the obvious, by commenting on the great amount of unemployment in the country. He also indicated that 75 per cent. of the money paid for the turbo-generator would be laid out in wages. Presumably the other councillors opposed to giving a British contract to British firms would prefer to see the expenditure on doles increasing by leaps and bounds as unemployment continued to increase as a result of their policy of buying on the Continent. In any case, their arguments are lamentably weak; a tailor would not go to America to buy his own suits when he can make them himself. Moreover, we do import manufactured goods and other produce which we cannot conveniently turn out in our own factories, so that, as free traders, we are not shutting Councillor Rowbotham's door on the foreign trader.

To Newport (Mon.) belongs the discredit of placing valuable work on the Continent rather than support home industries. The Newport Corporation passed a recommendation of the Electricity Committee to place a contract for a turbo-alternator and condensing plant with a Swiss firm at £29,432, as against a British tender some £13,000 higher. Certain speakers attempted to justify the decision by the fact that a condenser is to be supplied by a British firm, whilst the successful tenderers have agreed to purchase the steel for the plant from British steel makers. The fact that partly manufactured material is to come from this country, together with an insignificant portion of the complete outfit, does not justify sending the main contract to Switzerland whilst queues wait outside Newport Labour Exchanges and the difference in purchase price is more than absorbed in dole disbursements. When will the various city fathers adopt the broad view in connection with municipal contracts and realise that there is sufficiently keen and open competition among plant manufacturers in this country to ensure fair prices?

An Enjoyable Function.

The exhibitors' dinner, held at the Hotel Cecil last week, to mark the termination of six months hard work and close association of the various staffs of firms exhibiting in the Palace of Engineering at the British Empire Exhibition, was a great success. Over 400 attended, and did ample justice to an excellent repast. The toast list was brief, but the speakers, including Air Vice-Marshal Sir Sefton Brancker, Mr. Douglas Vickers, and Captain Alston, made topical references to the efforts of the various staffs and humorous allusions to certain shortcomings on the administrative side, which it is to be hoped will be removed if the Exhibition reopens next year. The dinner was followed by an excellent concert, whilst for those who preferred the light fantastic, there was every facility for dancing in the Palm Court. Great credit is due to Mr. Wildey, of the Port of London Authority, and an energetic committee, for the arrangements connected with this function.

Electricity Tariffs.

Apropos my recent comments on systems of charging for electrical energy, the Electrical Development Association have favoured me with copies of two of their publications appropriately devoted to this very question, and seeking to help educate the consumer to a better understanding of the advantages to be gained by the adoption of what is aptly termed "The Modern Way of Charging for Electricity." E.D.A. folder 379 goes a step further and indicates the approximate costs of operating such popular accessories as a vacuum cleaner, kettle, small fire and fan. This policy of publishing actual working costs is one which might well be developed to a far greater extent than it is at present. I only know of one catalogue of domestic electric appliances which includes a table of actual working costs based on a sliding scale of unit charges, so that a customer, knowing his local tariff, can at once refer to the table and make a mental calculation of the cost of operating any appliance in the list.

Salesmen, as a rule, are peculiarly reticent on the question of operating costs, whereas there is nothing to hide and everything to be gained by being honest with one's clients. The very small amount of energy consumed by such appliances as vacuum cleaners, irons, fans, kettles, bowl fires and the like, is an additional recommendation to purchase in all cases where a reasonable tariff prevails in the district. In dealing with an interested client, it is half the battle to be able to indicate the cost of operating the various appliances, taking into account the most likely periods during which they would be in service. Next to the first cost, the cost of current is also of importance, and many prospective buyers would probably clinch the bargain if they only appreciated the very small outlay required for operating current.

Christmas Gifts.

The festive season is rapidly approaching, and during the next few weeks the shops will be holding their annual exhibitions of attractive goods suitable for Yuletide gifts. The opportunity for the electrical trader to kill two birds with one stone is again apparent; by adopting and fostering the "Electrical Christmas Gift," he is not only appealing to his clientèle in the ordinary way of business with suitable and seasonable goods, but is also encouraging the more widespread use of electricity for a variety of domestic services. To those householders who already enjoy the advantages of a regular supply of "juice" there can be few more appropriate presents than suitable appliances for connecting to the existing wiring scheme, whilst a new consumer might conceivably be won over, or a decision finally secured, by the adroit presentation of one or two attractive fittings, an electric iron, or a vacuum cleaner.

As on previous occasions, the General Electric Company are well to the fore with their preparations for the Christmas gift campaign, and have an ample selection of suitable goods, ranging from wireless sets to "handilite" lamps. It behoves other firms to concentrate on this opportunity for spreading the electrical idea as early as possible: Christmas shopping will commence almost immediately and there is very little time to lose if sufficient stocks are to be on hand. Electrical goods lend themselves to effective and seasonable window dressing, and the Christmas gift idea, energetically pushed, should give a good fillip to the trade as well as to the supply authorities, who will benefit indirectly. The slogan—"Make Your Christmas Gift an Electrical One"—calls for the whole-hearted support of the entire industry.

Practical Electrical Engineering Hints.

I am pleased to hear from readers situated in numerous districts in Great Britain that the new feature, "Practical Electrical Engineering Hints," is meeting with general approval. I am not satisfied, however, that the feature should be merely appreciated. Of course I know that it is very nice to pick up a copy of ELECTRICITY and turn to this feature and read "how the other fellow did it," but what about the other fellow? He will be just as pleased to read and mentally digest how you did it. I know, many years ago, I was always pleased to receive a hint as to how "this" or "that" job could be most easily carried out. In those days I was often up against it, and many deviations from the standard practice of executing repairs, etc., were born through the fact that standard practices could not be applied. An armature winder plying his art away from the winding shop, an electrical fitter on an outside job, an electrician "making shift" with apparatus not intended for a job, but which eventually turns out to be better than the correct apparatus, all have stories to tell as to "how it was done." It is these stories, with clear diagrams, I want. Please sit down and send one along now. As a practical trade journal, ELECTRICITY exists to help its practical man, and one medium is through "Practical Electrical Engineering Hints."

Memories, Light and Otherwise.

From a strange quarter (no less a paper than the *Library World*) are forthcoming some electrical reminiscences. Mr. J. Dunlop, in dealing with the history of the Mitchell Library, Glasgow, refers to their electric plant in the early part of this century. The Library must have been an enterprising sort of place. I always feel inclined to raise a cheer for all those authorities and others who were daring enough to install their own generating plant and help to put electric lighting "on its feet." The Library in question is an instance, but the canny Scots retained gas as a stand-by. It seems they had good reason, for the engine had a habit of "stuttering to extinction on the busiest nights" (the *engine*, mark you—not the *dynamo*), and then the assistants had an exciting time pushing through the crowded reading-room to reach the gas lamps. Imagine some earnest student concentrating upon a tricky problem in electrical theory and just about to reach that climax when understanding would suddenly lighten his dazed mind; or (perhaps next to him) a youngster right in the middle of a thrilling exploit of Captain Thunder, when—out go the lights! And then, wouldn't it be adding insult to injury for a library assistant to barge into you and drop some hot wax down your neck? That library must have been a fierce sort of place. On a wet night it smelt like a laundry, for, it is said, the readers used the steam pipes for drying all kinds of apparel—even socks. H'm! If *my* laundry smelt like *that*—!

Dirty Work on the Farm.

Summer time has duly come and gone, and large numbers of people, unable to shake off old habits, are in a state of prostration through the strain of looking out for summer. Putting back the clock has convinced these good people that they might as well "give up." Let's settle down for the winter months! But there's no such luck for the hens. Some enterprising Johnnies have found that if summer time is kept up all the year round by artificial illumination, the silly old hens forget about their winter ca' canny policy, and (would you believe it!) somebody has proved that the egg production during the winter months goes up by 50 or 60 per cent. Moreover, 14 hours of lighting per day doesn't seem in any way injurious to the hens' health. Of course electric lighting is advised—I suppose because the hens might singe themselves, or the cocks knock the mantles off, if gas were used. Well, if it means more and cheaper eggs during the winter, more power to the fowlhouse. Let's hope the hens don't find out, though! And what's this?

Electrified Beehive.

An electrically controlled beehive, said to be the only one of its kind in England, was exhibited at Greater Felcourt Farm, East Grinstead. The diffusion of light and heat lures the bees from their hive to gather honey a month before the usual time. Phew! Even the bees are being "had." I said I hoped the hens didn't find out, but suppose the bees found *they* were being tricked? Gee! You wouldn't see my back for dust!

ELEKTRON.

ELECTRICAL ENGINEERING—GRADE I.*

Solutions to 1924 *Examination Questions of the City and Guilds Institute.*

BY EDWARD HUGHES, B.Sc. (Eng.), A.M.I.E.E.

(*Continued from page* 588.)

Q. 8.—What do you understand by the efficiency of a glow lamp? In what respects does a modern high-efficiency glow lamp differ from older types? Give reasons for these differences.

A. 8.—The efficiency of a glow lamp is usually expressed in C.P. per watt; though sometimes it is stated in watts per C.P. The latter, however, is a measure of the inefficiency of the lamp, since the higher the watts per C.P., the less efficient the lamp. The use of the term "efficiency" in reference to lamps is to be deprecated. By "efficiency" should be meant the ratio of output to input, both quantities being expressed in the same units. The value of the C.P. per watt for a particular lamp is no indication of the real efficiency of that lamp. Even for purposes of comparison, the value is ambiguous, unless the C.P. is taken as the mean spherical candlepower. The distribution of the light emitted by a lamp—apart from the effect of a shade—depends upon the arrangement of the filament, so that the term "candle-power," without some qualification, is meaningless.

The main difference between the high-efficiency glow lamp and the older types is the introduction of nitrogen or argon into the bulb. In the vacuum-type of tungsten lamp, the working temperature of the filament is limited by volatilisation to about 2050 C. Higher temperature gives rise to more rapid blackening and a shortening of the life of the lamp. Now the rate of volatilisation of the filament can be reduced by increasing the surface pressure, just the same as with the evaporation of water. Hence the introduction of a chemically inert gas into the bulb enables the temperature to be raised to about 2400 C. without excessive volatilisation. Unfortunately, however, the introduction of a gas affords greater facility for the heat to pass from the filament to the bulb, so that the gain in efficiency due to the higher working temperature is more or less neutralised by the loss of heat by convection and conduction through the gas. In order to reduce this loss to a minimum, the filament is made into a closely-coiled helix so that the effective surface presented to the gas is considerably lessened.

An incidental advantage of the helical filament is that it assists in prolonging the life of the lamp. If any part of the filament volatilises more rapidly than the rest, it becomes weaker mechanically; and the helix consequently opens out slightly at that place, so that the loss of heat is increased and local overheating or "spotting" is prevented.

The bulb of a half-watt lamp is made with a comparatively long neck, the object being to prevent overheating of the upper part of the lamp by the convection currents of gas travelling upwards. The long neck also allows the evaporated tungsten to be condensed there instead of on the lower part of the bulb, so that the latter remains almost free from blackening and the useful life of the lamp is thereby prolonged.

(*To be continued.*)

---

* Books recommended are *Elements of Electrotechnics*, by Young (7s. 10d. post free), and *Technical Electricity*, by Davidge and Hutchinson (13s post free), both from S. Rentell and Co., Ltd., 36, Maiden Lane, London, W.C 2.

ELECTRICAL MACHINERY EXPORTS.

According to the *Board of Trade Journal* for October 30 the group of electrical machinery comes third in magnitude among our engineering exports, and is also by far the largest in our retained imports. Relatively speaking, in terms of value it is to-day twice as important in both exports and imports as before the war, when our retained imports were equivalent to 38 per cent. of our exports; to-day they are at the rate of 12.9 per cent. The recovery in export trade since 1922 is very noteworthy, and characterises all branches of the industry except rotary converters and direct current generators, the former of which showed a decline and the latter was practically stationary in 1923. The rate of export of the first quarter of 1924 has been scarcely maintained in the subsequent months.

Before the war our imports came chiefly from Germany and the United States, with Sweden as a bad third; imports from all these countries fell off heavily in 1922, Belgium, France, Switzerland and Canada making moderate gains. In the export trade the chief features are the large decrease in exports to South American countries, especially the Argentine, and the considerable gains in exports to China, India, Australia and New Zealand. Some ground was lost in India in 1923 compared with 1922, but the result for 1923 was much better than before the war. Australia and New Zealand improved considerably on business in 1923, which in the previous year was rather below the pre-war level. The Union of South Africa made a very marked recovery in 1923 over the poor result of 1922.

List C. 12a, which has just been issued by **Crompton and Co.**, of Chelmsford, deals clearly with their large D.C. generators, of which there are illustrations and full particulars, as well as further illustrations showing various installations which have been fitted up by the company in various parts of the world. The list should therefore be of direct interest to all electric light and power installation contractors, to whom copies will willingly be sent on application.

ELECTRIC PASSENGER LIFTS.*

By H. Marryat (Member).

(Continued from page 580.)

Serious danger attaches to the drum method of driving, inasmuch as, in the event of overrunning and the failure of safety devices, the positively driven ropes will cause either the car or the counterweight to crash. With sheave driving the effect of over-running and failure of the safety devices is to land the car or counterweight upon the final stops at the foot of the well, and, with the ropes thus relieved of load, the gear can continue to revolve until the ropes are worn through, which will take many hours, or days.

The cost of maintenance of an electric passenger lift in business premises varies from about £20 to £100 per annum, and is largely affected by the frequency of re-roping. The cost of re-roping is largely made up of labour, and is often augmented by the necessity for overtime work, but, apart from the actual cost of the ropes and work, a further loss must be taken into consideration in respect of the discontinuance of lift service whilst the work is in progress.

A prime consideration in the selection of a lift should therefore be the ultimate maintenance cost, with particular regard to re-roping, and to accept tenders for lifts without this consideration is to place a premium on inefficiency.

Frequently the breaking strain of the ropes to be employed on a new lift is specified without regard to the fact, supported by lift engineers having long experience of maintenance, that a rope of less tensile strength, of super-ductile class, will in many cases give better results over a number of years. If such ropes are to be employed, care must be taken in the first instance that the lower breaking strain is compensated by larger, or additional, ropes, to provide the necessary factor of safety.

Both lift and rope makers differ in their advice as to the most suitable rope for use in any particular case. My own experience suggests the use of a super-ductile steel for ropes which fail on account of damage by bending, and a hard steel of high tensile strength for lifts on which the ropes fail from the frictional wear due to slip between the ropes and the driving sheave.

A most important factor affecting the life of ropes is the method of reeving employed. The option to select the best method is often taken out of the hands of the lift maker by the architect, who advances his plans too far before the details of the lifts are considered, and imposes hampering restrictions.

In Fig. 7 are shown diagrammatically the methods of reeving more usually employed, in (*a*), (*b*), (*c*) and (*d*) the winding engine being indicated at the head of the well, and in (*e*), (*f*), (*g*) and (*h*) at the foot.

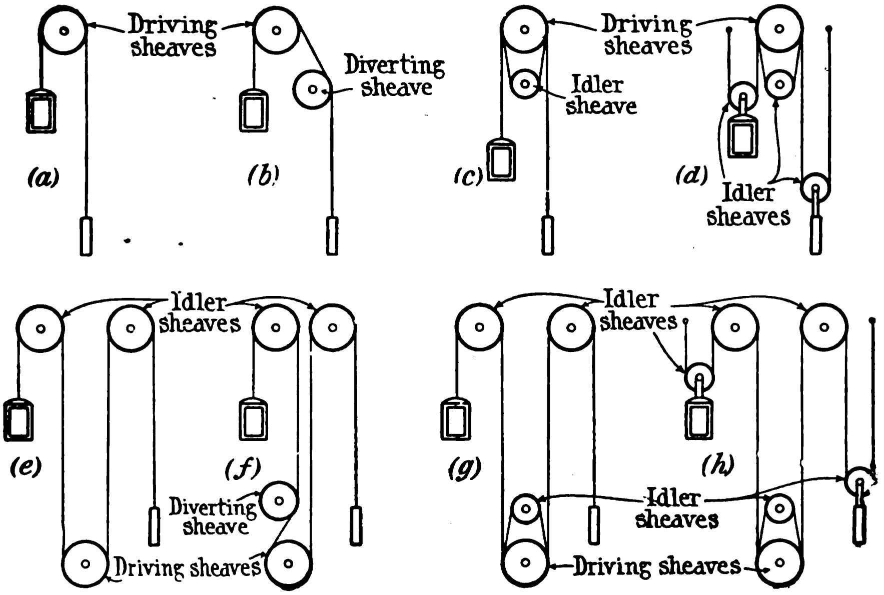


Fig. 7.

The ideal arrangement is indicated in (*a*), in which the driving sheave spans the distance between the suspension points of the car and counterweight. Arrangement (*b*) is not so satisfactory, but may be necessitated by considerations of economy, because the smaller the diameter of the driving sheave the less expensive are the motor and gear, or because the distance between the car and counterweight centres is too great to be conveniently spanned by a single sheave, or in order to comply with the particular building plan. Arrangement (*c*)—sometimes termed the "full-wrap drive"—may be employed where the out-of-balance load is considerable and there is danger of rope slip on the driving sheave. It is possible with this method of reeving to employ **U** grooves instead of the usual **V** grooves on the driving sheave, thereby greatly reducing the wear on the ropes. With this arrangement the idler sheave may be so placed [as in (*b*)] as to act as a diverting sheave in cases where the driving sheave cannot be designed to span the distance between the car and counterweight. Arrangement (*d*) shows an adaptation of reeving which may be applied to (*a*), (*b*) or (*c*), introducing a 2 : 1 reduction in car speed. This method and further extension of the same principle may be conveniently employed when very heavy loads have to be raised at low speed. It will be noticed that in this diagram is introduced for the first time an **S** or backward bend in the rope. Such bends should be avoided where possible as they are much more destructive than a series of bends in the same direction.

---

* Paper read before the Institution of Electrical Engineers.

Diagrams (*e*), (*f*), (*g*) and (*h*) show similar arrangements, but with the winding engine at the foot of the well. In these arrangements the lengths of the ropes are greatly increased, and S bends are introduced in every instance. The arrangement with diverting sheave shown in (*f*) is for some reason, which I am not prepared to explain, exceptionally destructive of the ropes.

Whatever system of reeving is employed, the larger the diameter of the sheaves used the longer will be the life of the ropes. In these diagrams only one rope is indicated, but it must be understood that in passenger lift practice from four to six or more ropes running side by side are employed.

It will be seen that the winding engine may be placed at the head of the well directly over the work, at the foot, or on any of the intermediate floors. The advantages claimed for placing the gear at the foot of the well are:—

(1) Greater accessibility.

(2) Greater rigidity and therefore longer life.

(3) Less likelihood of nuisance due to noise and vibration.

In practice I find these advantages largely non-existent, whereas the obvious disadvantage of employing ropes of at least treble the length is very evident. Not only is the cost of ropes and of reroping increased on account of this greater length, but the wear of the ropes is also increased by the larger number of bends—often S bends—which the ropes must make.

It is true that under certain circumstances the wear on the ropes can be reduced by so arranging the position of the winding engine that that part of the ropes which passes over the driving sheave does not also pass over the top sheaves—and *vice versa*; but even where this is done, unless diverting sheaves can be eliminated, the wear is greater than with the plain see-saw arrangement with the winding engine at the top.

The increased cost of maintenance due to a bad roping scheme may easily be sufficient to justify several hundreds of pounds capital expenditure in the first place, and may be avoided altogether if proper provision is made in the original plans.

One objection which architects and builders occasionally advance to the placing of the winding engine at the top of the building, is the increased weight on the upper structure. Examination will show that there is nothing in this argument except in the very unusual event of the winding engine weighing more than the combined weight of the car, load and counterweight. Under all other conditions the strain upon the upper structure is greater if the winding engine is located below.

(To be continued.)

Quotations Wanted.—The Argentine National Sanitation Works Administration, Buenos Aires, invites tenders for the supply and delivery of two sets of vertical shaft centrifugal pumps operated by electric motors.——The Ministry of Railways, Marine, Posts and Telegraphs at Brussels invite tenders for the supply of telephone tables and sets of jacks.——The Argentine State Oilfields Administration invite tenders for (1) the supply and (2) the erection of the electrical plant and materials required for sub-stations and high and low tension distribution systems. Specifications, etc., at the Department of Overseas Trade (Room 52), 35, Old Queen Street, London, S.W.1.

NEW DESIGNS IN G.E.C. HOME OFFICE PATTERN SHIELDED LAMPHOLDERS.

The regulation No. 21 on page 60 of the memorandum on the Electricity Regulations, 1924, requires holders to be either earthed, or "made of, or completely covered with, suitable insulating material, so that neither the holder nor the metal cap of the lamp can be touched." Hitherto, this regulation has been taken as referring only to the ordinary bayonet cap lampholder, and until quite recently only lampholders of this type were obtainable shielded to comply with Home Office regulations.

The General Electric Co., Ltd., however, inform us that at the suggestion of the Home Office they have now completed their series of Home Office pattern shielded lampholders by the addition of Edison screw holders and G.E.S. holders, which are adequately protected by insulating shields. The development in recent years of the use of high candle-power gasfilled lamps having Edison screw or G.E.S. caps renders this protection very necessary, as it must be remembered that the whole of the metal part of the cap of such lamps is alive when the lamp is switched on, and some particulars of these new types of lampholders will, therefore, be of interest to readers. For example, in the standard Edison screw Home Office pattern lampholder mica insulation is used between the centre contact and the screwed liner, while the insulating shield is of "Wittonite" fireproof insulating material, and an efficient cord-grip as well as substantial wiring terminals are provided.

Next they are now marketing the G.E.S. Home Office pattern lampholder, which is a standard G.E.C. "Goliath" holder in china case, with ½ in. gas or ⅝ in. brass thread entry at the top. Around the base of this holder is clamped, by means of small bolts and nuts, a moulded cylinder of Wittonite made in two halves, and of such proportions that it adequately eliminates all risk of the metal part of the lampholder or lamp being touched. Where ordinary unshielded G.E.S. lampholders are already installed these may be easily protected, as the insulating cylinder or sheath can be obtained separately, under Catalogue No. S.1249. Finally, in their standard G.E.C. Home Office pattern B.C. holder, the new form of cord-grip possesses slots in the bridge piece between the two terminals, thus replacing the usual hole and facilitating wiring.

Sweden.—The survey of business conditions in Sweden, given in the *Swedish Economic Review* for the third quarter of 1924, shows that there have been few changes and trade remains fairly satisfactory, although a complete recovery from the effects of the war has not yet been attained.

Change of Address.—The British Thomson-Houston Co., Ltd., have transferred their Cardiff office from 7, Park Place to more commodious premises at 26 and 27, St. Mary Street, Cardiff. Tel. No. Cardiff 5258 (2 lines). As much larger stocks can be carried, it is hoped that the move will still further improve the service rendered to trade customers.

E.D.A. Salesmanship Conferences.—In view of the number of requests that the first Conference of the present session should be repeated, Mr. W. E. Bush has been good enough to consent to read his paper: "A Programme for Intensive Lighting Development," at the E.L.M.A. Lighting Demonstration Service Bureau, 15, Savoy Street, W.C.2, on Friday, November 14, at 7.30 p.m. Everyone engaged in any branch of the Electrical Industry is welcome, and tickets for circulation amongst the staffs of Supply, Manufacturing and Contracting concerns are ready. Any number required will willingly be sent on application to the E.D.A., at 15, Savoy Street, W.C.2.

THE INTER-CONNECTION OF POWER STATIONS.*

The first I.E.E. informal meeting of the session was held on Monday October 27, when the president, Mr. W. B. Woodhouse, took the chair and opened a discussion on " The Inter-connection of Power Stations."

Mr. Woodhouse has very extensive first-hand knowledge of this subject, and his opening was a masterly summary of the considerations involved.

The address made no unusual claims, and the hard knocks the president said he expected the subsequent discussion to deliver were not attempted, but a keen and useful debate ensued in which seventeen speakers took part.

Mr. Woodhouse said the subject plainly divided itself into three sections: (1) Technical, (2) economic, (3) agreements for inter-connection. Some of the economic considerations affected by inter-connection are when it produces a reduction in cost of generation by saving of coal, or a reduction in cost by maintenance of load factor if it better ensures continuity of supply, or reduces the capital invested in spare plant without reducing security. He made diagrams illustrating the unevenness of local conditions which a station may undergo and the smoothing-out of these irregularities that may be obtained if inter-connected stations be skilfully taken advantage of. He also showed what may be done by taking advantage of the diversity of load factor in the different parts of an area.

The technical considerations are not so simple, but we have now reached the time of inter-connection at high pressures, and if transformers are suitably selected the reactance can be accounted for. On the question of protective devices he sought the opinion of the members present, but he thought the ordinary risks of interruption had been overcome.

Agreements for inter-connection are matters of quite easy adjustment and may be made subject to periodical consideration of the use each connected station had made of the arrangement. They need not affect ownership of lines nor the cost of the inter-connection.

Mr. H. M. Sayers said he was glad to see the emphasis with which Mr. Woodhouse stressed the importance of running-plant load factor. Then, too, the time of steam-raising was a consideration not always sufficiently recognised. He knew of stations of very good load factor with very poor stand-by efficiency. He advised a careful study of a time-table of known and predetermined loads. He felt a real difficulty of inter-connecting stations was that somebody must say which station should run and which shut down.

Mr. J. H. Sandiford spoke of the inter-connection of three London systems that had no transformers in the lines, but got over the difficulty by adding external reactance. One consideration of inter-connection was bulk supply and the comparative costs of switch gear.

Mr. A. G. Hilling also knew of stations satisfactorily inter-linked by plain split conductors without transformers.

Mr. W. F. Andrews reminded the meeting of one great advantage of inter-linking, in that it provided occasional week-ends for overhaul of plants. His experience of an inter-linked system was that there was not the difficulty Mr. Sayers anticipated in obeying the mandate of the local despatcher, nor was there any dispute over the cost of transferred loads.

Messrs. J. R. Bedford, F. E. Berry, W. Brooksbank, Dr. R. D. Gifford, V. N. Halliday, A. F. Harmer, R. V. Hook, T. R. Renfree, J. W. Robertson, W. E. Roberts, J. P. Shipley, A. J. Watts and A. Williams also spoke.

Mr. Woodhouse, in reply, said that in respect to the price of transferred loads you ought to be able to make an agreement that will concentrate the generation in the most efficient plant. With regard to the threat to small stations, we had reached the economic necessity of getting rid of the small generating set, at any rate. As to large industrial plants, this point had special interests for districts like South Wales or Cleveland, where they do considerable steam generation. It is not difficult to inter-connect these works nor for them to deliver current to the system, as they run to the steam pressure gauge as the main consideration.

OSRAM CHRISTMAS TREE LAMP OUTFITS.

This year the outfit of Osram Christmas tree decoration lamps offered by the G.E.C. is extremely artistic and practical.

Each consists of a suitable number of 7-watt 14-volt Osram lamps of a pleasing olive shape and assorted colours, together with a length of wire complete with miniature Edison screw holders and adapter, packed in an artistically decorated cardboard box convenient for storing. A marked advance on previous outfits is the adoption of moulded material for the body of the lampholders, while the use of two single flexible wires, instead of twin twisted flex, greatly increases the number of ways in which they may be employed.

Two standard outfits are listed, one for low-voltage circuits, having eight lampholders wired in series, and nine lamps, and the other for high-voltage circuits, having sixteen lampholders and eighteen lamps. Further, they are catalogued at prices which should prove a popular and attractive feature of this year's Christmas trade, and dealers are advised to take advantage of the short Christmas season by stocking these outfits, and above all by showing them in their windows and in their showrooms. They are particularly suitable for window display, one or more outfits

---

* Precis of discussion.

arranged either on a small Christmas tree or as festoons in the window, together with a few of the attractive cartons in which they are packed, forming a complete display in itself. There should also be a good demand for them from shopkeepers for windows and showroom decoration, Christmas bazaars, etc.

We illustrate herewith the complete outfit as described in the new folder, which can be obtained from the General Electric Co., Ltd. It is being circularised to the trade, and supplies overprinted with the dealer's name and address will be available upon application.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid or the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 191.

How can I convert my crystal receiving set into a one-valve set with a minimum expense?—"ASTATIC."

QUESTION NO. 192.

In the plant at our colliery, our motor load is running at .6 power factor. How can I improve this? Would it be better to improve this to unity power factor or to some value below unity?—"A. F. JAMES."

(*Replies to Questions Nos.* 191 *and* 192 *must be received not later than November* 29, 1924.)

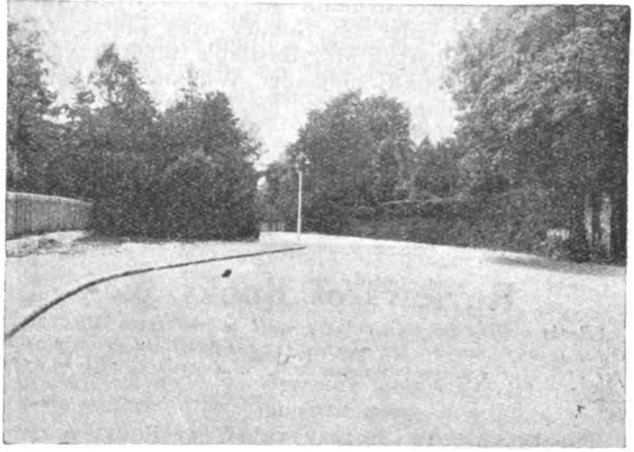
INCREASING USE OF AUTOMATIC SUB-STATIONS.

The reliability of automatic sub-stations has been very thoroughly demonstrated in the United States, where the first equipment was installed about ten years ago, and the number now in service totals several hundreds. In this country the automatic operation of sub-stations is a much more recent development, but, due to its importance, is receiving rapidly increasing attention; in fact it is not generally recognised that while the actual number of such stations operating in this country is small, considerable numbers have been, and are being, built here. As an indication of this it may be stated that the British Thomson-Houston Co., Ltd., Rugby, has manufactured or has on order 41 automatic sub-station equipments, totalling nearly 72,000 kw., for use in this country and overseas. The machines are either rotary converters or synchronous motor-generator sets according to the conditions to be fulfilled, and operate on supply frequencies of 25 to 50 cycles, giving output pressures from 400 to 3,000 volts D.C.

These automatic sub-station plants are being used for electric traction, power, or mixed power and lighting loads; thus their adaptability to every class of service is demonstrated. By the proper choice of size and location of the equipments the cost of feeders as well as operating charges may be reduced to a minimum and at the same time the best possible voltage regulation is obtained.

A NEW USE FOR COLOUR-SPRAYED LAMPS.

The general application of colour-sprayed lamps has been so successful that it is not surprising for one to learn occasionally of special services for which these lamps are employed. For instance, a certain amount of road widening has been done in Maidstone recently, but where this widening ceases it was considered desirable to erect a warning light, and our illustration shows the marking of the end of the widening of the main arterial road, pending its completion through Maidstone, where an ordinary street lamp standard and fitting equipped with a 60-watt red colour-sprayed Osram lamp is used for the purpose described. Mr. E. E. Hoadley, M.I.E.E., the Borough Electrical Engineer, affirms that this outfit has provided him with an excellent danger warning.



One way to keep a good mental balance is to have a good bank balance.

The Engineers' Club (London).—The following meetings of interest to our readers will be held at the club during November:—7th, Inst. of Aeronautical Engineers; 8th, R.N. Division Signals; 14th, Diesel Engine Users' Association, R.N. Division Signals; 17th, Inst. of Rubber Industry; 20th, Inst. of Mining and Metallurgy Council Club dinner; 21st, Inst. of Aeronautical Engineers; 26th, Batti-Wallahs Society; 27th, Institution of Locomotive Engineers; 29th, Finsbury Technical College Old Students' Association.

Motor Shipbuilding.—The November issue of the *Motor Ship* contains various articles of interest to electrical engineers, including a description of the auxiliary electrical machinery on the new 10,000-ton tanker "British Motorist," which has just been built by Messrs. Swan, Hunter and Co., of Wallsend-on-Tyne, and a reference to the 15,000 b.h.p. double-acting, two-stroke Diesel engine, which will be installed in the Hamburg Electricity Works, and will be the largest Diesel engine yet constructed. Details are also given of the electrical machinery used on the Great Lakes motor ship "Henry Ford II.," which has been built for carrying coal and ore for the Ford Motor Works at Detroit.

CHARLES ORME BASTIAN.

The funeral took place last Monday at the Golder's Green crematorium of the late Charles Orme Bastian, Member of the Institution of Electrical Engineers. The deceased was born in 1869, the eldest son of late Dr. Charlton Bastian, Fellow of the Royal Society, and was educated at University College School and University College, afterwards studying electricity at the old Hanover Square School of Electrical Engineering under the late Dr. W. Lant Carpenter. He then went to Messrs. Crompton's works at Chelmsford, and for a time was engaged at the Hampstead Central Station in its early days. Deceased had a great inventive genius and patented many improvements, especially in regard to the use of radiant heat. He was a pioneer of modern methods of electrical heating and the inventor of the well-known Bastian meter as well as of the "Quartzalite" heater, the Bastian water heater and a thermal storage geyser. He was also a frequent contributor to the electrical Press. The deceased's only son Stanley was killed in the Great War in 1915. Mr. Bastian's funeral was attended by Surgeon-Commander William Bastian and Mr. James Bastian, brothers, Dr. William Hill, cousin, Lieutenant-Commander F. J. Campbell Allen, partner of the firm of Bastian and Allen, Mr. Samuel Landman, and representatives of the staff and workpeople of the Bastian Meter Co., and Messrs. Bastian and Allen.

Reviews of Books, &c.

[Books noticed in this column will be sent from ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

THE ELECTRICAL CONTRACTOR'S YEAR BOOK, 1924-25. Cloth. 355 pp. (Electrical Contractors' Association, 3s. net, post free.)—The new edition of this very businesslike year book opens with an excellent portrait of Mr. Walter Riggs, A.M.I.E.E., the new president of the E.C.A. Allied Organisations, or, as he is more familiarly known to his many friends, "The Admiral," followed by a list of the present council and officers and of the members as at June 30 last. Then we have a brief history of the E.C.A. from its inception in February, 1901; an excellent account of the activities of the three associations; the president's report, from which it is very pleasant to see the high reputation which the E.C.A., etc., now holds in the profession and the harmonius relations with the E.T.U.; and a brief but clear outline of the E.C.A. trading policy. Full details are also given of the new National Register of Electrical Installation Contractors as well as a copy of the form of application for membership thereof, together with valuable data in regard to legal points affecting electrical contractors and their customers, the position of apprentices, and particulars of other associations conected with our industry and with which the E.C.A. members may come into close contact. It is also a pleasure to note the kindly reference to Mr. Kennedy, the new editor of the *Electrical Contractor*, and altogether the book is crammed from cover to cover with information of direct value to every electrical contractor in the British Isles.

Civilisation follows the bath tub.

Trade Notes.

List No. L60, which has been issued by the **Foster Engineering Co., Ltd.**, of Morden Works, Wimbledon, S.W.19, gives illustrations, details and prices of the latest types of lanterns for gasfilled lamps as manufactured by them. They are supplied with opalescent globe and lamp-holder, and the cases contain a special device by which the latter can be adjusted to enable any make and size of lamp to be used.

The November issue of the regular monthly price list has just been issued by the **Siemens and English Electric Lamp Co., Ltd.**, of 38, Upper Thames Street, E.C.4. As usual, it contains illustrations, prices and details of practical lines, which will appeal to all installation contractors and engineers, and copies will willingly be sent on application.

The October issue of the *A.S E.A. Journal* has just come to hand from the **Swedish General Electric Co.**, of 5, Chancery Lane, W.C.2. It contains an interesting and practical article on the variable-speed three-phase shunt commutator motor, together with diagrams, and it will therefore prove of direct interest to every reader of this paper who is in any way a user of or trying to obtain information with regard to this type of machine. Another article deals with the overhead construction of the Drammen Railway. Altogether it is a very readable issue.

A well-printed leaflet describing and illustrating the "Sphinx Anti-Dazzle Head Lamp" has been issued by **Auto Bulbs, Ltd.**, of 112, High Holborn, London, W.C.1. The company claim to be the largest manufacturers of automobile lamps in the world, and the list should be of direct interest to all dealers in these goods.

Heating of Glass Houses.—An interesting paper on this subject was read at a recent meeting of the Inst. of Heating and Ventilating Engineers by Mr. E. S. Shoults, A.M.I.E.E., who gave the grower's point of view in connection with the subject, and referred to the problems which confront the grower in the course of his business as being of a fundamentally different type to those encountered by engineers in general.

The Salary That Spells Satisfaction

Three years ago one of the largest and most famous electrical concerns in Great Britain asked us to recommend to them a suitable man from among our Students. We recommended several. The one selected was 20 years of age and his commencing salary was £150 a year.

To-day, after experience in South America and the North of England, he is doing important work in London and being paid £450 a year.

At the age of 23—just at the beginning of his professional career—that young I.C.S. student is in a position and earning a salary which most middle-aged men of much experience would be glad to have.

What the great electrical firm employing him think of I.C.S. students is shown by the fact that they have just asked us to recommend to them *six* more men of our training.

(The name of this firm and of the student will be given on request to genuine inquirers.)

Is it not worth your while to find out just what the I.C.S. can do for you in your own home and at your own time? That will place you under no obligation.

Write to-day for full information as to how the I.C.S. can help you in your chosen vocation. There are 300 I.C.S. Courses, including the following in various branches of electricity:—

Complete Electrical Engineering.
Generator and Motor Design.
Hydro-Electrical.
Electric Lighting.
Electric Traction.
Electric Wiremen's.
Water-Power Electrical.
Mining Electrical.
Professional Examinations.
Steam-Electric.
Gas-Electric.
Engine and Dynamo Running.
Lift Operation and Maintenance.
Armature Winding and Repair.
Telegraph Engineering.
Telephone Engineering.

International Correspondence Schools, Ltd.,
36e, International Buildings, Kingsway, London, W.C.2.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

NOVEMBER 14, 1924.

CONTENTS.

	PAGE
Encourage Ideas of Engineers and Reduce the Costs of Production	617
Audio-Frequency Transformers	618
Our Wireless Corner	618
Radio Valves	620
Current Topics	623
Electric Road Vehicles	624
Questions and Answers by Practical Men	625
Electrical Engineering—Grade I.	626
Electric Passenger Lifts	627
Rotary Converters for Railway Use	628
Reviews of Books	629
'Daily Chronicle" Photographic "Happiness" Competition	629
Various Items	630

ENCOURAGE IDEAS OF ENGINEERS AND REDUCE THE COSTS OF PRODUCTION.

By an Engineer.

[The following article is reprinted from the October issue of the "A.E.U. Monthly Journal," and we commend it to the notice of our readers because we should like to hear their views if any of them have any communications to make on the subject. We are right out for the fullest harmony between employers and men, and we think it very short-sighted policy indeed for any works manager to snub or belittle the suggestions of any workman who has ideas on the subject of increasing output or improving the efficiency of the machine on which he is working. In fact, it seems hardly credible, although we accept the writer's assurance that it is so. On the other hand, in this country the trade unions have made such a dead set against profit-sharing and co-partnership schemes that, generally speaking, a really clever workman hardly dares to make suggestions which would make for increased efficiency or cheapen the production costs. It would mean trouble with the shop steward and most probably a fine at the next meeting of the local branch. By all means let us aim for the harmony to which the contributor refers. It would be an enormous stride towards the economy which is needed to meet foreign competition.]

It is a fact well known in trade union branches that production costs in many of the big engineering shops could be substantially reduced if the employers would condescend to be a little more tolerant towards the working engineers in their employ, and listen to what they have to say instead of curtly pointing out to them that they pay others to do that sort of work—meaning that the job of the artisan is to get as much as he possibly can out of the machines he operates, and leave such matters as new ideas to those who follow another profession.

That is the spirit which animates the majority of the big machine and fitting shops which are established in this country; but across the Atlantic it is, speaking generally, just the reverse, and I may mention that I have had experience in several American establishments in one industrial district alone, and in six different works in this country. I know, therefore, of what I speak.

What is wanted in this country is a little more tolerance between master and men, and until we get the same amount here as obtains in most of the American works we shall, I fear, continue to hear the moanings of our manufacturers because they cannot compete with the foreigner.

One of the main reasons why production costs in our motor and general engineering works are so high is because the working engineers and the draughtsmen in the drawing-offices are not allowed to put their heads together as they should.

The only time one can see the average engineer in conversation with a man from the drawing-office is when the foreman has been compelled to send up to the drawing-office for someone to be sent down to the shop to explain some obvious error on the blueprint, which would never have occurred had the men who have to do the job been consulted beforehand.

And what makes matters worse the mechanics often meet snobbery in the drawing-office itself. In some offices the chief regards himself as a man who knows all, and he is encouraged in this delusion by many of the "superiors," who walk and lounge about the works month in and month out.

That is all wrong. What is sadly needed, and, indeed, urgently required in many British engineering works, is a full spirit of harmony which can only be brought about through the mediation of works managers, whose real function in American works is to stand between the whole of the employees and their employer.

The long bays of fine machine tools which are such a feature of most of our modern engineering shops cannot be exploited to the full until the technical and mechanical workers work with each other to the mutual benefit of the whole firm.

What the technical man has got to realise is that his livelihood depends as much upon the ability of the mechanic as the latter's living depends upon the inventive ability of the draughtsman, and until both these classes of workers pull together, the costs of production cannot be lowered to any appreciable extent.

Why is it that the engineers in the shop leave the young draughtsman who has been sent for some practical experience on the lathe in the cold? Why is it that the draughtsmen always pour cold water on all the ideas of mechanics that find their way into the drawing-offices? The answer to both questions can be given in one word, "jealousy."

The working engineer who has had cold water thrown on a practical idea long before it has reached the right man cannot be expected to help a "cold water thrower" to gain further recognition by mastering the intricacies of the lathe, and when that draughtsman gets back into his drawing-office again, after perhaps twelve months on the lathe, he cannot be expected to help one of the men from the machine shop put his ideas on to paper. So it goes on, but it is all wrong, and until matters are righted British manufacturers will have to go on along the same thorny paths and take the good with the bad.

But does one find this sort of thing taking place in America? Not a bit of it.

If British motor manufacturers want to learn something about scientific and economic production they cannot do better than pay a visit to Detroit.

There they will find the secrets of success. They will find, too, how the automobile firms treat their workpeople, and will find out then why it is that those who leave this country never want to come back until they are forced by domestic circumstances.

American firms tell their operatives straight that they don't care how much money they earn so long as their work is done right. It is not so here. I can name a big firm in the Midlands that is sacking some of its best men now because they are earning too much. The firm don't like to pay it out, and that is the top and bottom of it.

As to ideas, every firm in America encourage them, and pay for them, and help the originators to put them into shape. Every idea is considered and, if practical, is exploited to its utmost. No matter whether it is a time-saving device or a device that is calculated to lengthen a job by giving it a better finish, they will go through the same channels and through the same test. The Americans have found that it pays them to concentrate on ideas—so why not us?

AUDIO-FREQUENCY TRANSFORMERS.

On Friday, October 31, at the Junior Inst. of Engineers, Mr. H. J. N. Riddle delivered a lecturette on "Audio-Frequency Transformers," in the course of which he said that audio-frequency transformers were commonly used in telephone systems to compensate for long lines of high resistance as well as in conjunction with thermionic valves for magnifying microphonic currents. A transformer had to deal with frequencies from 14 to 40,000 cycles per second, all audible to the human ear, and the efficiency of the general type of transformer was by no means the same over the whole range. Some transformers responded more to high frequencies, others more to low frequencies. The design of a transformer to fulfil a certain purpose was always determined by experiment, and not by calculation on paper, on account of the numerous factors which were concerned. Inductance, capacity, amount of wire, and size of wire were all variable and dependent on one another, and the value of the first two, at any rate for a particular design, could not be ascertained without actual experiment. The transformer should be designed, also, to suit the apparatus with which it was to be worked, and for wireless work especially very few pieces of apparatus had exactly the same characteristics.

Mr. Riddle demonstrated clearly the effect of eliminating high or low frequencies in a transformer by placing different capacities across the primary coil. The transformer used was of the hedgehog type, and was not what could be called a refined production, and yet proper adjustment to its surrounding apparatus, including the receiver, gave excellent results. The use of an ordinary telephone transformer for intervalve work was also successfully shown.

Many of the points of construction were mentioned, including the arrangement of the coils and the core, and the finishing off of the windings.

He who tells what he would do if he were there, was never there.

Our Wireless Corner.

THE CHARACTERISTIC SURFACE OF THE THERMIONIC VALVE.

This heading is the title of a bulletin just recently issued by the University of Washington Engineering Experiment Station, and written by Mr. J. R. Tolmie. It is a brief article outlining a method of representing thermionic valve characteristics by means of surfaces, rather than by curves. Such a method would appear to lead to a clearer representation than is possible by the more common method. The bulletin is, of course, a technical paper, and in the main is only of interest to those directly working with thermionic valves, where their characteristics are of special technical importance. For those who wish for a copy, the number of the bulletin is 24, and it could be obtained through the office of this journal, price 2s. 9d. post free.

THE LIBERTY SAFETY WANDER PLUG.

The majority of valve failures are due to accidental connection of the high-tension battery across the filament circuit of the valve, and therefore any device which would satisfactorily prevent a burn-out of the valve filament, when this accidental connection is made, should be a very great advantage as an additional component of any receiver.

We have received from Messrs. Radi-Arc Electrical Co., Ltd., of Regency House, Warwick Street, W.1, a Liberty Safety Wander Plug. This plug is used as the positive wander plug on the H.T. battery. The sample that we have had the pleasure of testing is made up in a semi-transparent red insulating material and has quite an attractive appearance. It consists of the plug, which is attached to a tubular portion containing a special resistance material, at the other end of which a terminal is fitted. In the case of bright valves, this resistance material has a value of about 500 ohms, so that in use it is impossible to burn the valve filament out accidentally should the H.T. be connected across it; that is, of course, providing this safety wander plug is included in the H.T. circuit.

Tests were carried out with this plug, and it should be specially noted that the sample sent us was for bright valves. The plug was used on a 66-volt H.T. battery, and connections were taken direct to the filament terminals of the valve, and it was left connected for some time. The resistance of the wander plug was sufficient to prevent the filament even glowing a dull red.

Although the plug was of the type to be used for bright valves, the same test was tried using a valve with a filament taking .06 ampere. In this case the filament was slightly overrun, but nothing like enough to do any serious damage, unless left connected for a long time.

The company, we believe, make the wander plugs for use with dull-emitter valves, and these would appear to be equally satisfactory with those made for bright valves.

Tests were then made to see if the resistance introduced into the H.T. circuit made the circuit noisy. This, however, is far from the case. The circuit conditions were quite quiet.

We then passed through the resistance of the new plug, various currents up to about 100 milliamps. for fairly long periods, and then again tested it in circuit to see if it had gone noisy, due to the passage of this comparatively heavy current through it. The plug, however, still functioned quite silently, and was not in any way impaired.

At the comparatively low price at which the plug is sold, it would appear to be an ideal arrangement to use with broadcast receiving sets.

At first view one would think that the volt drop would be very considerable and the full value of the H.T. battery would not be obtained. This, however, is not the case. The volt drop is quite small, and very little difference in signal strength is noticed when the resistance portion is short-circuited.

THE WIRELESS EXHIBITION IN CHICAGO.

One hundred and eighty of America's leading radio manufacturers and twenty of the most famous wireless concerns of England, France, Italy, Germany and Japan will be among the exhibitors at the Third Annual Chicago Radio Show, which is to open on Tuesday afternoon, November 18, and gives every promise of equalling the extraordinary artistic, financial and scientific success of the recent First Radio World's Fair in New York City. Over £1,000,000 worth of apparatus, covering every phase of the enormous industry, will be on display, and it is a certainty that the attendance will break all local records. One recognised authority on such matters estimates that at least two hundred thousand people will attend, which is twenty-five thousand more than passed through the turnstiles in Gotham. All of the exhibits of the First Radio World's Fair will be on view here, together with several ultra-important new features. Among the latter will be some French receivers, tubes and battery eliminators, just perfected by a celebrated Parisian electrical wizard, which threaten to revolutionise radio reception. These startling devices, which are not yet on the market, will be given their very first public demonstration here. They will not even be shown in France until after their Chicago introduction. There will also be some unusually interesting official Italian and Japanese exhibits which failed to arrive in time for the Manhattan exposition. Thousands of jobbers and dealers from the United States and Canada, together with a few hundred from South America, Europe and the Orient, will attend the big show, and two hours per day—from 11 a.m. to 1 p.m.—will be set aside for the exclusive transaction of business between these wholesale buyers and the exhibitors.

NEW LITERATURE

Catalogue 595, Wireless Sets and Accessories, which has just been issued by Siemens Bros. and Co., Ltd., of Woolwich, is a new edition of the May issue. As regards the receiving sets, the B.B.C. contribution no longer obtains, and the prices of the crystal and the well-known C.V. type receivers are now substantially reduced. A very complete range of accessories is listed, including telephone head sets, loud-speakers, aerial equipment and primary cells and batteries. They are also issuing to retailers and dealers a new headphones showcard (the Nightingale), which is of a particularly attractive design. It is lithographed in nine colours, and copies are available, either varnished or unvarnished, upon proper business application.

Another striking advertisement which is certain to appeal to wireless dealers is the new Marconi-Osram valve showcard which the General Electric Co., Ltd., have prepared for this season and are now distributing. It is attractively designed and printed in seven colours, and features prominently the purple box in which all Marconi-Osram valves are now sold, and by displaying the card in windows or showrooms dealers will be definitely linking up with the huge publicity campaign which is being undertaken in connection with these celebrated valves. Copies of the showcard will be forwarded to dealers upon application to Magnet House, Kingsway, W.C.2, or any of the company's provincial branches.

Messrs. A. J. Stevens and Co. (1914), Ltd., of Wolverhampton, are now very well known in wireless circles, and some months back we had the pleasure of briefly reviewing the original instruction and information booklet, compiled with a view to assisting their customers in the erection and operation of A.J.S. sets. We have just received the second and revised edition of this booklet, and the information it contains makes it of use to all prospective receiving-set purchasers. One of the additions in the latest issue is a series of sketches showing different types of buildings, and suggested arrangements of aerial and earth connections. These sketches, together with other information on the erection of aerial and earth circuits, gives to the most uninitiated a very clear idea of what is necessary for obtaining best results from a receiver.

This booklet also has other valuable information on connecting up, lists of various types of valves, with filament and plate voltages required. The use of indoor aerials is described, and the booklet further treats with the use of rejector circuits and the causes of failure, or those producing unsatisfactory results. The final page is headed "Dont's," and to those who have just entered the realms of wireless reception these "Dont's" give valuable advice, which, if followed, will prevent to a great extent the present complaints of interference and oscillation. At the price of 6d. it gives good advice to all those about to purchase wireless receiving apparatus, and we have no doubt Messrs. A. J. Stevens would gladly send a copy to prospective customers, but to prevent indiscriminate application for copies it becomes necessary to retail it at a nominal figure.

WIRELESS RECEPTION OF ELECTION RESULTS.

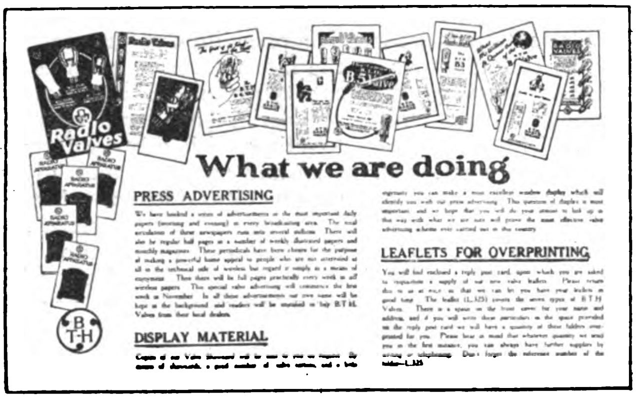
As usual, wireless played a large part in the recent General Election, and numerous demonstrations throughout the country were given at which the election news broadcast from all stations of the B.B.C. was reproduced by loud-speakers. One of these was organised by Wireless Service, Ltd., at the Ladies' Carlton Club, where a "Gecophone" two-valve set, comprising one stage of high-frequency amplification and detector, was used, in conjunction with a "Gecophone" two-stage amplifier and connected to three "Gecophone" loud-speakers. It proved a great success, the members remaining in the club until the broadcasting station closed down for the night.

Tenders Accepted.—The G.P.O. have accepted the tender of the Edison Swan Electric Co., Ltd., for a supply of all-porcelain switches.

RADIO VALVES.

ENTERPRISING ACTION OF THE B.T.-H. CO. TO INCREASE DEMAND.

With the ever-expanding development of wireless transmission and the constantly increasing demand for valves for receiving sets, the problem of satisfactory supply and rapid manufacture has been one which has occupied the attention of more than one of the more important firms connected with the electrical industry, amongst whom none have been more assiduous or given greater importance to the very technical details connected with successful results than the British Thomson-Houston Co., Ltd. When it is remembered that probably at least half a million valve receiving sets or amplifiers are now in use in this county alone, and that every day that number is being added to, some conception may be formed of the size and importance of the valve market, and it is impossible to assign a limit to its ultimate extent. There are three main factors which contribute to the enormous demand for radio valves, viz. :—


Radio Valves
B T-H

What we are doing

PRESS ADVERTISING

LEAFLETS FOR OVERPRINTING

DISPLAY MATERIAL

FIG. 1.

1. The normal increase in the number of licence holders.
2. The replacement of crystal sets by valve sets.
3. The widespread tendency amongst users of valve sets to add additional amplifying valves from time to time.

The British Thomson-Houston Co., Ltd., recognised from the first that a very large demand must arise within two or three years, and prepared for it. B.T.-H. radio valves originated with the war, and were supplied in quantities for the various war departments of the Government, and at the present time this factory is probably one of the best equipped in the country for its particular production.

One of the most notable features of B.T.-H. valves is their extreme "hardness." This is but another way of saying that they are very highly exhausted, and this feature has only been attained by a vast amount of research and by overcoming tremendous difficulties in the devising and equipment of specialised apparatus, leading to the development of the present B.T.-H. process of exhaustion. A "soft" valve is merely one in which a little air remains, and most of the cheap foreign valves are more or less inclined to "softness" because they are cheaper to produce and do not require the very expensive and elaborate machinery which is needed in order to produce the far more efficient and satisfactory "hard" valve.

Radio valves are rapidly becoming a standardised product in almost universal demand, and the British Thomson-Houston Co., Ltd., are wisely advertising their special range of radio valves, comprising six distinct types, on the widest possible scale, and are not merely appealing to actual valve users of receiving sets. They are providing retailers throughout the country with specially designed showcards and printed matter for display and distribution to their own customers. Some examples of these are shown in our illustrations, and would be supplied with the retailers own names and addresses.

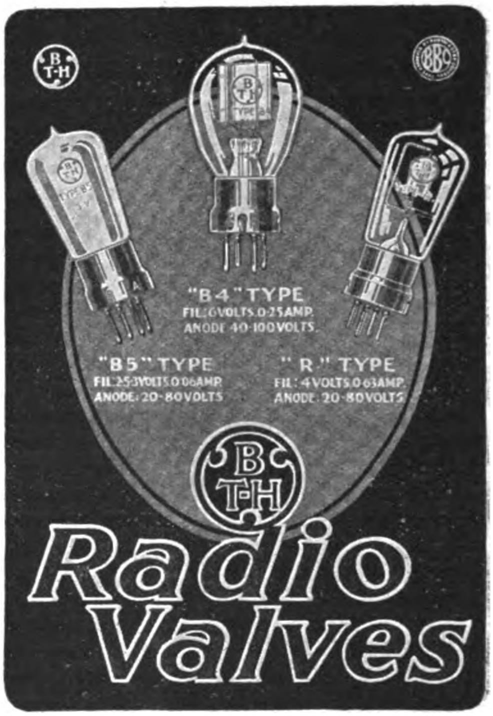


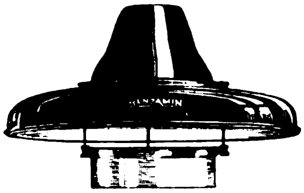
FIG. 2.

It should be obvious to such dealers in radio valves that it is to their distinct advantage to recommend to their customers a valve such as the B.T.-H. radio valve unquestionably is, and the quality of which is assured by the solid reputation and stability of the manufacturer, rather than to push the sale of cheap, foreign or inferior valves, which, instead of producing a repetition of orders, will only bring his customers back, if at all, to lodge bitter complaints.

We congratulate **Messrs. J. Halden and Co.**, the well-known drawing materials specialists, on the October issue of their bulletin, "The Arc." It is a well printed and most interesting production, containing matter which will appeal to a very large number of the readers of this paper, and we would, therefore, suggest that application for copies be made to them at 8, Albert Square, Manchester.

Various novelties in the form of combination electric cookers, electric fires and electric heaters generally are now being placed on the market by **Perfection Electric Heaters**, of 10, Bard Street, Sparkhill, Birmingham, and installation contractors as well as dealers in these goods generally should make a point of writing to the company and asking for full details. They will willingly be furnished on application.

Brilliant Light Without Glare
The BENJAMIN BIFLECTOR



The latest contribution to scientific illumination.

Ideal for Spinning Frames, Weaving Looms, Compositors' Frames, Offices, Schoolrooms, Hospitals, etc., etc.

Advt. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription : 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited, and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL & CO., LTD., 36-39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

The Aftermath.

To those who have practically lived at Wembley during the past six months there is something tragic and forlorn in the present aspect of the vast buildings and grounds, now undergoing the evacuation and demolition processes. In the Palace of Engineering many of the familiar electrical exhibits have already been removed, stands pulled down and avenues cleared ready for the later removal of the heavier goods. One misses the persistent hum of the power station, the many coloured lights and the noise of traffic. It is astonishing the progress made in one week in clearing away exhibits and plant which took months to erect prior to the opening of the Exhibition. The famous "Flying Scotsman" and "Caerphilly Castle" locomotives went out quite early in the week following the official closing, thus demonstrating the advantage of immediate access to a permanent way.

The overhead electric cranes are daily demonstrating their utility in handling the heavier machinery in the main avenues, whilst the moving of all classes of exhibits has abundantly proved the extreme handiness of the self-contained electric trucks. These little vehicles can carry considerable weights, manœuvre round the sharpest of corners, reverse, and, in short, negotiate floors and openings which would be impracticable for any other vehicle. During the installation period, throughout the duration of the Exhibition, and now as aids to its evacuation, these handy vehicles have proved their transport value over and over again. As a result they will doubtless find service in many factories and warehouses where they have not hitherto penetrated. Prior to the B.E.E. they were mainly familiar to the public as railway platform trucks at the main termini, but their use at Wembley must have brought them to the influential notice of many interested manufacturers and others looking for improved transport facilities.

Judging by the wholesale removals in the B.E.A.M.A. section of the Palace of Engineering there will be an entirely new arrangement of exhibits should the decision to reopen next year be confirmed. Practically all the firms exhibiting this year have either removed their exhibits and demolished their stands or are in process of so doing, and next year's show, if it matures, will be something entirely different to that which has just closed its doors. I understand that even the power station plant is to be dismantled and removed, whilst the necessary stand-by supply for lighting the main buildings and grounds during the winter months will be drawn from the mains of the North Metropolitan Supply Company. It is far easier to pull down than to build up an engineering display of the character of that at Wembley, and if it is seriously intended to open next year, plans to that end will very soon have to be made and the work of preparation commenced as soon as the buildings have been cleared of their present contents, otherwise the same old cry, "It won't be ready in time for the opening," will arise again in the early spring of 1925.

Scrap.

The demolition of stands and the dismantling of electrical gear and exhibits is creating a considerable quantity of scrap materials in the shape of V.I.R., flex, lampholders, switches, cut-outs and associated fittings, much of which will be unfit for further service without reconditioning. It is really amazing the waste and damage entailed in fitting up and dismantling some of these exhibits. Six months service soon takes the bloom off otherwise perfectly sound and saleable goods, and there will be heavy depreciation on most of the smaller electrical goods displayed at the B.E.E. There will be miles and miles of wire only fit for the scrap-heap, whilst the breakage bill in connection with incandescent electric lamp bulbs will doubtless prove gratifying to the E.L.M.A. These fragile items suffer mostly in the demolition process, and, where due precaution has not been taken to remove them as a preliminary to any other process, there is bound to be a large percentage of breakages. In fact, the occasional popping of bulbs in various quarters of the Palace of Engineering is quite a noticeable feature of the many noises accompanying the removals.

Safe Electric Traction.

The safety of travelling by electric railways could not have been better exemplified than by the service afforded between Baker Street and Wembley Park by the Metropolitan Railway during the Exhibition. There were literally hundreds of trains per day running in both directions, many of them packed to the limit of accommodation, and there was no mishap during the whole period. Track circuiting ensures signalling safety and eliminates the fallible human element, whilst the flexibility of the service was apparent to all who had occasion to make use of it. I understand that the electrification of this line, which now extends only as far as Harrow, is to be extended farther afield and that work is already in progress to this end. As it is at present, there is an excellent service of fast non-stop trains both morning and evening for City men living in Wembley and Harrow districts, enabling them to reach town from their homes and return from their offices in the City in less than half an hour, including the London tube connections at Baker Street. The influence of a modern electric service in developing new residential districts is apparent all along this route and should be an inspiration to other suburban railways to follow suit and electrify as early as possible.

"Lighting Effects."

Dear, dear—here's a tragic happening. When a Hounslow preacher was delivering his sermon the other evening the electric lamp in the pulpit went off pop. Whether the points in the sermon were being emphasised too much for the lamp's stability or not report doth not say. But anyway, pop went the lamp, and then the congregation *did* wake up. The vicar's surplice was on fire! One of the newspapers (oh, these newspapers!) rose to the occasion with the heading of "A Fiery Discourse." I'm reminded of another discourse which might have had much more of a fireworks display. One of the foremost political leaders was visiting the town, and the suffragettes were on his track. They persuaded a University student known to me to crawl underneath the stage from which the political leader was to speak, and there, with the aid of a hacksaw, he was to *cut the electric mains*. The brave fellow, as I say, crawled to his post, but there (although he was a student of *botany*) something warned him to sheer off—so, like a wise man, he *did!* The speech was duly interrupted, but vocally. There were no fireworks.

How to Tell When Steam is up.

Not long ago in these columns I told the story (true, as it happened) of the man in charge of a village lighting scheme who knew when a fault existed by the big flash from the switch and by being bowled over in addition. I have just heard a somewhat similar story (also true, I am assured), and although it is not about electrical gear it is apposite enough to quote here. This time the *expert* had a small boiler and steam engine to look after, and the visitor (a mechanical engineer who happened to "blow in") was astonished to find no gauges or other guidance fitted; the whole plant was in a ruinous state, and he himself would have considered it suicidal to fire-up. The owner-operator, however, had no fears at all. It was a case of "where ignorance is bliss——!" He was asked as to just what he did when starting-up. "Oh," he replied, "I fill up with water and get the fire going." That seemed natural enough—but how did he tell about his steam pressure and so forth? "Why," said he, "I just carry on getting up steam until the engine starts!" This seems rather fierce for modern practice. I should think that if ever a boiler inspector drifts in there he'll have a fit on the spot.

Power from "Rubbish."

Glasgow is again to the fore. A "super-station" is now being built which will deal with 300,000 tons of house refuse yearly; this material is to be incinerated, and from the heat developed it is hoped to generate 58,000,000 units of electricity per annum, the residue being available for road-making and building purposes. The scheme is not absolutely novel, for there is at least one city in England which runs a large section of its tramways from refuse which formerly was dumped at sea, but it is certainly thoroughgoing. One is shown very clearly from this how electricity (itself the most flexible of all our various forms of energy) again provides the best medium. It is amazing and, as it will seem in the future, incredible how wasteful we have been of our natural resources. Take, for instance, coal—that great heritage which has played such a tremendous part in our engineering developments and in our overseas trade. With coal we have been utterly profligate. It is only during recent years that it has begun to dawn upon us that all the wealth in coal has been only partially utilised. Just imagine! At colliery after colliery the coal that was hewn and brought to surface with such efforts was put into ovens near the pithead and made into coke for use in blast furnaces; and all the products of the coal which went off in the form of gas or otherwise, and most of the incidental heat, were *waste*.

But we live and learn. Not only are the chemical products in these cases now carefully trapped, but the gases are guided to the boiler-house of a neighbouring power station and there used. It is the writer's lot to visit many of these plants, and it is extraordinary to consider how many thousands of kilowatts are made available by such means. In the case of one waste-heat station the gas comes from blast furnaces several miles away and is burnt in a most spick-and-span boiler-house, about 20,000 h.p. being developed. All sorts of refuse fuels are being used or investigated. Not only is ordinary house refuse of benefit, but general factory waste could be burnt. Coke breeze, which in the past has been thrown away from gas-works and the like to the extent of millions of tons, turns out to be a material of worth-while value and, in modern plant—alone, or with coal or coke—it yields excellent results. As many readers will know, the coal which is nowadays used at power stations is what in the past was classed as rubbish, and is bought at but a few shillings per ton.

ELEKTRON.

ELECTRIC ROAD VEHICLES.

At the general meeting of the Institution of Automobile Engineers, which was held on Tuesday last at the Royal Society of Arts, John Street, Adelphi, London, W.C.2, at 7 p.m., Mr. Dudley E. Batty, A.M.I.E.E., read a paper entitled "The Electric Road Vehicle: Its Characteristics and its Economic Field of Usefulness." The author first of all compared electrical and thermo-dynamic terms and discussed the thermal efficiencies of producing electrical energy by various types of prime movers. He drew attention to the high efficiency obtained with internal combustion plants in small units. The characteristics of the series motor and its adaptability for road vehicle work were brought out and comparative curves given of a vehicle electrically driven and one driven with petrol engine and gear box. The accuracy of measurements and simplicity of testing electrical vehicles is of great use to the designer of petrol vehicles. After referring to the trolley 'bus, various electric transmission (torque converters) were described. The battery was next dealt with, its various constructions and battery characteristics. Methods of battery charging were discussed.

The last part of the paper dealt with the economic side and the particular sphere in which electric vehicles find their greatest usefulness. It will, we are certain, interest a large number of our readers, so we shall try to publish a more complete abstract of it in an early issue of this paper.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid or the question which we select for competitive replies in this column.

ANSWERS: A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at he top left-hand corner of all letters intended for this column.

QUESTION NO. 191.

How can I convert my crystal receiving set into a one-valve set with a minimum expense?—"ASTATIC."

QUESTION NO. 192.

In the plant at our colliery, our motor load is running at .6 power factor. How can I improve this? Would it be better to improve this to unity power factor or to some value below unity?—"A. F. JAMES."

(*Replies to Questions Nos.* 191 *and* 192 *must be received not later than November* 29, 1924.)

Answers to Questions.

QUESTION NO. 184.

The second prize (5s.) has been awarded to "D. T." for the following reply:—

The question set by "Frequency" is not full enough to allow precise details to be given for the 6,600-volt overhead line for which he wishes information. To obtain complete information, it would be necessary to know the power transmitted and the transmission distance, the remaining factors being assumed from average figures for similar lines.

The design of any overhead transmission line is to a certain extent governed by the regulations of the Electricity Commissioners. We start our calculations and design with the knowledge that the completed line must comply with the following regulations:—

The factor of safety of line conductors shall be 2, and shall be based on the breaking load and calculated on the assumption that the line conductors are at a temperature of 22 deg. F., and have a covering of ice to a radial thickness of half an inch, and that they are simultaneously subjected to a wind of 50 miles per hour at right angles to the line. This wind to be taken as exerting a pressure equivalent to 8 lb. per square foot calculated on the whole of the projected area of the ice-covered lines.

The weight of ice to be taken as 57 lb./cubic ft.

Modulus of elasticity for copper 18×10^6.

The height from ground of any line conductor at any point on the span at all temperatures below 122 deg. F. shall not, except with the consent of the Electricity Commissioners, be less than 20 ft.

With these facts before us we proceed with the design.

The first calculation to be made is that determining the conductor size. This is based initially on an assumed spacing if the limiting factor in determining the conductor size is voltage drop. Therefore, if the spacing and percentage of voltage drop are assumed, knowing the load and approximate power factor, the size of conductor can be determined from a series of vector diagrams, or from the usual formula:—

$$\text{Volts drop} = \sqrt{3}\,(R\,I\cos\phi + \phi\,L\,I\sin\omega).$$

Where R = Total resistance of one conductor.

I = Current per conductor.

$\cos\phi$ = Power factor.

$\omega = 2\pi \times$ frequency.

L = Inductance of line phase to neutral.

$\sin\phi = \sqrt{1-\cos^2\phi}$.

After taking one or two conductor sizes and working out the voltage drop, a size will be found which gives a voltage drop approximating to that which can be permitted. The type of support is next determined, this depending on the size of conductor. With a large conductor and consequent heavy loading a lattice steel tower would be used. An average economic span for this type of support is about 300 ft. Having now obtained the span and conductor size, the sag, at 122 deg. F., is calculated, and the spacing checked to determine whether the wires at the centre of the span when under the maximum wind load will give the necessary electrical clearance between wires. For a 6,600-volt line with a span of 300 ft. a spacing of 3 ft. 6 in. is sufficient for conductors not less than .075 sq. in. area.

An earth wire has to be erected under the conductors in order to earth the conductor in the event of a conductor breaking. An average size for the earth wire is about 7/No. 14 or 7/No. 12 s.w.g. galv. steel strand, 40-ton quality. This earth wire must be earthed at four points in every mile, and the usual form of earthing device is a flat cast-iron plate buried not less than 5 ft. below ground level. For a 6,600-volt line of average capacity an earth plate 3 ft. sq. by $\frac{3}{8}$ in. thick is necessary. The earth plate is banded to the tower by means of a flat copper strip. As each tower carries the earth wire on an insulated fitting, each tower is effectively earthed.

The guard wire referred to by "Frequency" is a wire sometimes placed above the phase wires to act as a lightning conductor. It is supposed to be effective in protecting the line if all the wires are included in an angle of 60 deg. below this guard wire. The tendency with modern lines, in this country in particular, is to rely on efficient lightning arresters to discharge any static charges induced on the conductors themselves, rather than to erect a guard wire which does not prove so efficient in this country as lightning arresters. On all straight line poles on the route pin insulators would be used for this voltage, and at angle and terminal poles strain insulators of the disc type are satisfactory. At each end of the line on the terminal poles it is necessary to include choking coils and lightning arresters to protect the underground cable from heavy surges with steep wave fronts, which would break down the insulation of the cable. The effect of the choke coil is to smooth out the steep front of the surge wave, and thereby reduce the potential gradient at this point, and also to a certain extent reflect the wave which would spill over the arrester and so to earth.

These details are very general, as the subject is a vast one and the calculations lengthy. I shall be pleased to work out a concrete case if this will assist "Frequency" to understand the application of the principles.

ELECTRICAL ENGINEERING—GRADE I.[*]

Solutions to 1924 *Examination Questions of the City and Guilds Institute.*

BY EDWARD HUGHES, B.Sc. (Eng.), A.M.I.E.E.

(*Continued from page* 609.)

Q. 9.—A cable is required to supply a 50-h.p., 250-volt motor, situated 100 yards away from the distribution centre. Find the cross-sectional area of the cable needed if the drop in the leads on full load is not to exceed 4 per cent. The specific resistance of the material of the cable is 1.66 microhm per cm^3. Assume motor efficiency = 0.85.

A. 9.—Efficiency of motor $= \dfrac{\text{B.H.P.} \times 746}{IV}$

$$\therefore 0.85 = \frac{50 \times 746}{I \times 250}$$

$$\therefore \text{I} = 175.5$$

But voltage drop in cable at full load = 4 per cent. of supply voltage,

$$= \frac{4}{100} \times 250 = 10$$

$$\therefore \text{resistance of cable} = \frac{10}{175.5} = 0.0569$$

$$\begin{aligned}\text{Total length of conductor} &= 2 \times 100 \text{ yards} \\ &= 2 \times 100 \times 36 \times 2.54 \text{ cm.} \\ &= 18{,}300 \text{ cm.}\end{aligned}$$

If a = cross-section of conductor in sq. cm.

$$\therefore 0.0569 = \frac{1.66 \times 10^{-6} \times 18{,}300}{a}$$

$$\begin{aligned}\therefore a &= 0.534 \text{ sq. cm.} \\ &= 0.0828 \text{ sq. inch.}\end{aligned}$$

This gives a current density of 2120 amps per sq. inch, a value that is far too high. Possibly the examiners may have meant the total length of conductor to be 100 yards. The wording of the question, however, is quite definite.

Q. 10.—How would you measure (*a*) the armature resistance of a shunt dynamo with carbon brushes; *b*) the field resistance; (*c*) the insulation resistance to frame? Give reasons for the different methods adopted.

A. 10.—In order to measure the resistance of the armature, one end of the shunt winding F is disconnected, whilst the armature winding is connected in series with an ammeter A and a variable resistance R across the supply. If it is required to eliminate the brush-contact resistance and thus obtain the resistance of the armature winding alone, the voltmeter connections must be made directly to the commutator segments on which the brushes are bearing. It is advisable to take readings for two or more positions of the armature core, since the number of short-circuited coils is different for different positions of the commutator. In this way the average effective resistance of the winding can be determined.

If the voltmeter leads be connected to the brushes instead of the segments, the brush-contact resistance is included; and since the latter is approximately inversely as the current, it is necessary to measure the resistance with the current at which any calculation is to be made.

The field resistance is determined by measuring the current produced through the field windings by the supply voltage, the connections being as shown dotted in Fig. 5. Should the supply voltage be much higher than the rated voltage of the machine in question, it would be necessary to connect a resistance in series.

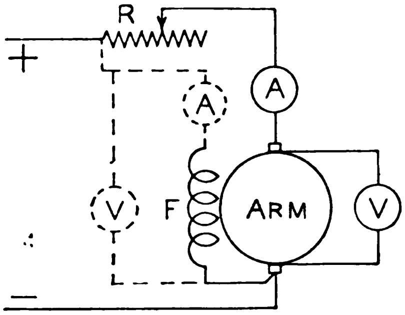


FIG. 5.

The simplest method of measuring the insulation resistance is to use a direct-reading instrument such as the Megger. With the machine disconnected from the mains, one terminal of the Megger is joined to the brushes and the other terminal to the frame. The reading thus obtained is the insulation resistance of the whole machine. If it is desired to measure the insulation resistance of the armature and field separately, the brushes are lifted off the commutator and the Megger is first connected across the commutator and shaft, and then across field and frame. The second reading includes the insulation resistance of the brush gear, but this can be eliminated by disconnecting the field winding at both ends.

(To be continued.)

An illustrated list giving details and prices of electric pulley blocks for all kinds of industrial purposes has just been issued by **Messrs. Jos. Adamson and Co.**, of P.O. Box 4, Hyde, Cheshire. It is claimed that these electric blocks represent very considerable economy in lifting and carrying work in factories, and they will therefore be of direct interest to contractors who have to fit them in mills, factories, shipyards, etc., as well as to the engineers in charge of actual power plant. The list will willingly be sent on application.

---

[*] Books recommended are *Elements of Electrotechnics*, by Young (7s. 10d. post free), and *Technical Electricity*, by Davidge and Hutchinson (13s post free), both from S. Rentell and Co., Ltd., 36, Maiden Lane, London, W.C 2.

ELECTRIC PASSENGER LIFTS.*

By H. MARRYAT (Member).

(*Continued from page* 613.)

For low-speed lifts, such as are usual in this country, it is essential to interpose some form of gearing between the motor and the driving sheave. Many types of gearing have been tried, but the worm and wheel is almost universally employed because of its many advantages for this particular work. Worm gearing is conveniently built to give precisely the ratios required by the lift engineer, and can be readily designed with a suitable angle of lead to render the gear self-sustaining; that is to say, so that it shall not be possible for the load or counterweight to set the lift in motion by driving the motor back through the gear. This provision requires the efficiency of the gear to be no more than 50 per cent., but the value of this additional safety factor is so great that the loss of efficiency is willingly sacrificed in order to secure it.

Figs. 8 and 9 show two typical arrangements of winding engine, comprising motor, worm gear, brake and sheave. The fundamental difference lies in the arrangement of the worm gear. In Fig. 8 the worm is located below the wheel, whereas in Fig. 9 it is above the wheel. I do not know that the comparative advantages of these types for this purpose have ever been discussed, and lift makers are divided in their opinion and recommendation. To the casual observer I think it will appear at once that the over-worm type is the sounder engineering job. With this arrangement the low-speed main shaft—that carrying the whole of the weight—is placed low down upon the bedplate in the most favourable position. The main part of the bedplate is hollow and forms an ample receptacle for oil, with easy access for cleaning out the bottom of the gear-case so formed.

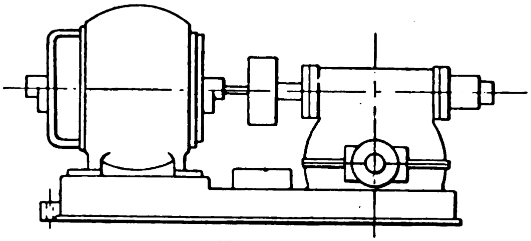


FIG. 8.

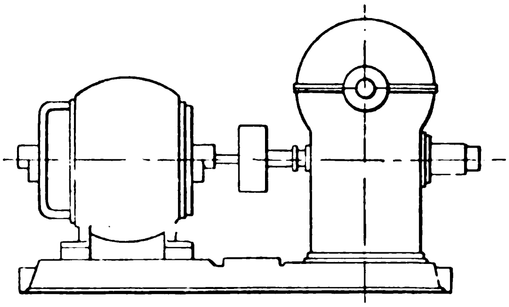


FIG. 9.

The advantages advanced by advocates of the under-worm type are, first, that the lubrication is more perfect, and secondly, that any wear taking place in the main shaft bearings allows the gears to drop closer into mesh instead of drawing the worm and wheel apart. On the question of lubrication it is true that with the over-worm type gear the worm is not running immersed in oil, but oil more than sufficient to provide ample lubrication is brought up by the hollow teeth of the wheel. If the inspection cover of such a gear be inadvertently removed whilst the gear is running, it will quickly be replaced to staunch the flood of oil which is thrown by centrifugal force from the worm. The gear case is so designed that this oil thrown from the worm is collected in gutters and conveyed to the worm and main shaft bearings, whence it finds its way back into the reservoir, which is kept filled to a height of some inches above the teeth of the wheel. With this type of gear the main shaft bearings, which are the most important in the whole machine, are subjected to a continuous flow of oil passing through them. The answer to the second point is that if the main shaft bearings wear so much as to make an appreciable difference in the mesh of the gear it is time for these bearings to be re-bushed. To meet extreme cases where no backlash of any sort is permissible between the worm and the wheel (these cases do not, in fact, concern lifts, but occur in certain pumping problems), a device of wedges below the main shaft bearings is introduced by means of which very fine adjustment of mesh can be obtained.

It will be observed that the over-worm type of gear that I am advocating is the more expensive, and, if it has the superiority I claim, deserves a due allowance in the consideration of competitive tenders.

For high-speed lifts such as I have advocated in the earlier part of this paper, the American practice of coupling the driving sheave direct to the motor without the intervention of gear may be employed. In this case the motor must, of course, be of very low speed and correspondingly expensive, and, as the self-sustaining feature of the worm gear is lost, additional precautions must be taken against accident.

Two methods of control are in use with modern electric passenger lifts; these may be referred to briefly as the "push-button" and the "car-switch." The push-button method is automatic, that is to say, the car stops automatically at the floor desired and the lift can be operated by the passenger without the assistance of a lift attendant. The car-switch method requires the employment of a lift attendant and some skill to ensure stopping at floor level.

The push-button lift is the more expensive, but the difference in cost is far more than justified by the saving in the cost of attendance. Its capacity is, however, far less than that of a car-switch lift of the same size, because there is some difficulty in employing a higher speed than 150 or 200 ft. per min. with an automatic lift, and because a single passenger on entering the car obtains complete control over the lift until he has completed his journey, although there may be many passengers waiting at intermediate floors. The automatic lift is therefore only suitable for places where the traffic is never so dense as to require the full capacity of the lift for many minutes at a time. The scope of the automatic lift might be considerably extended by the introduction of a satisfactory self-closing gate to overcome the annoyance of the lift being thrown out of action by some careless passenger forgetting to close the gate after him, and by the incorporation of a suitable floor-levelling device which would permit of a higher running speed being employed. Lift makers are engaged upon these problems, so that there is a possibility of some advance being made in the direction of increasing the capacity of automatic lifts.

---

* Paper read before the Institution of Electrical Engineers.

Automatic control lends itself to many variations in detail, but the general principle is much the same in all cases. One push-button is fixed at each landing gate, and this will call the car to that landing provided it is at the moment disengaged and that all other landing gates are closed. A series of buttons fixed upon a tablet in the car—one button corresponding to each floor served—enables the car to be directed to any particular floor by pressing the corresponding button. On arrival at that floor the car will stop automatically. In a typical arrangement the push-buttons are connected to a series of relays representing each floor by means of a circuit which is completed through contacts attached to each gate, so that when a button is pressed—subject to all gates being closed—the particular floor relay will operate. This relay closes the circuit of one or other of two coils operating a change-over solenoid switch affecting the direction of rotation of the motor; also a solenoid the function of which is to overcome the force of the springs holding the brakes in position; and finally a solenoid operating the motor-starting rheostat. The particular solenoid which comes into operation in connection with the change-over direction switch depends upon the position of the car in the well at the time, so that, if the car is at the foot of the well and the button for the first floor be pressed and the direction of rotation is found to be clockwise, then if the car is at the fifth floor and the same button is pressed the direction of rotation will be counter-clockwise.

(To be continued.)

ROTARY CONVERTERS FOR RAILWAY USE.*

By Reginald William Mountain, B.Sc., Stud. Inst. C. E.

In the first part of the paper the author describes the present position of the rotary converter in the problem of power-supply for heavy traction, and its relation to other forms of apparatus for converting electric current from one form to another.

The special characteristics of all electrical machines intended to assist in the task of supplying current for heavy traction are of extreme importance, and have a controlling influence on the design, so that the author has commenced the paper with short comparison of the various forms of current used for electric railways. After finding the conditions under which continuous current is most useful, a comparison is made between the various methods of conversion, particularly from three-phase high-tension supply.

The author then explains the methods that have been adopted to produce a rotary converter capable of fulfilling the rigid and exacting requirements of traction work, and these results are compared with those obtained from the mercury-arc current-rectifier, the cascade converter, and the motor-generator set, when working under similar conditions.

In the second part of the paper detailed results are given of some trials carried out upon rotary converters designed specially for railway use, and the results are discussed from the standpoint of traction demands. The rotary converters described were built for the French *Chemins de fer du Midi*, and they are designed for a line voltage (continuous current) of 1,575 to 1,650 volts, with an output of 750 to 2,250 kw.

Three-phase current is generated at 8,000 volts and 50 cycles, and is distributed to the sub-stations at 60,000 volts. The railway sub-stations are located at intervals of 10 to 18 miles, and are connected directly to the 60,000-volt system.

The exacting nature of the tests described in this Paper with regard to short circuit and to continuous overload, and their effects upon the commutation and the operation of the converter, give some idea of the special characteristics of modern traction supply, and how the difficulties met with can be overcome.

FARADAY HOUSE OLD STUDENTS' DINNER.

The annual dinner of this association was held at the Hotel Cecil on October 31, Mr. R. N. Vyvyan, M.I.E.E., Engineer-in-Chief to Marconi's company, the president of the association, being in the chair. The toast of "Faraday House" was proposed by Mr. W. B. Woodhouse, the president of the Institution of Electrical Engineers.

He pointed out that Faradians were holding leading positions in almost every country in the world, and that the work they were doing was of great national importance. In his reply Dr. Alexander Russell, the principal, reported the continued prosperity of the college. The workshops, laboratories and testing rooms had all been practically re-equipped during the past year. He gave a list of recent successes obtained by Faradians. The toast of "The Guests" was proposed by Mr. Charles Sparks, and responded to by Sir Charles Morgan, D.Eng., the president of the Institution of Civil Engineers, and by Sir John Snell, the chief electricity commissioner. A letter was read from Mr. W. H. Patchell, the president of the Institution of Mechanical Engineers, regretting his inability to attend as he was in America. Finally, the Right Hon. F. Kellaway proposed the health of the chairman in an eloquent speech, and in his reply Mr. Vyvyan expressed his regret that the League of Nations did not take up the subject of improving international relations by issuing approved histories of national events.

A musical programme concluded a most enjoyable evening, the performances of Miss Hayward-Webb and of Mr. Ronald W. Gourley, the blind entertainer, being received with enthusiasm. Approximately about 180 members and guests were present.

Cookstown (Co. Tyrone).—At the Urban Council recently it was decided that the Gas and Light Co. and Cookstown Electric Light Co. should both be given permission to erect standards on the streets for conveying overhead electric wires.

Coleraine (Co. Derry).—The Urban Council has decided that the electricity supply works generating station will be erected on the Fair Hill, adjoining their gas works, and that the area of supply will be the urban district and the district within three miles radius of the urban boundaries and that the maximum charge will be 1s. per unit for lighting and 6d. per unit for heating and power purposes, with a minimum charge of 5s. per quarter.

---

* Abstract of a paper about to be published by the Institution of Civil Engineers.

Reviews of Books, &c.

[Books noticed in this column will be sent from ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

METALLIC RESISTANCE MATERIALS FOR ELECTRICAL PURPOSES. (1s. 2d. net post free.)—A revision of the British Standard Specification for Metallic Resistance Materials (No. 115), first issued in 1921, has just been published. The sizes of wire included in the first issue had been criticised in some quarters, and these were reviewed, but evidence was given that they were coming into more general use, and the conclusion reached by the committee was that it was inadvisable to make any considerable modifications at the present time. The only important changes are the addition of a smaller size of wire, namely, 0.002 in. diameter, and a schedule of thicknesses of silk and cotton-covered wire, based on general practice, has been included in an appendix for the convenience of users; the other changes in the specification being of a minor character.

PROCEEDINGS OF THE INSTITUTE OF RAILWAY SIGNAL ENGINEERS: PART I., FEBRUARY-AUGUST, 1924. (7s. 6d.)—This is an interesting volume which will appeal to the very large number of electricians who are employed in connection with the telegraphing and signalling systems of the railways of the United Kingdom. Electricity is making such rapid additions in this particular direction that papers describing the latest developments are certain to be of direct educational value, more particularly when they are accompanied by such excellent diagrams as are given at the end of this volume, and we can therefore cordially recommend it to our readers. We note with interest that on page 31 there is a list of the names of the various firms who are now only historical, and the writer can add one to that list, for instance, Messrs. Tweedy, of the Railway Signal Works, Carlisle. Forty years ago they had a well-known name as signalling engineers in the North of England, as well as a good Indian and Colonial connection. The book also includes a list of the members carried to August 31 last, and congratulations are due to the Hon. Sec., Mr. M. G. Tweedie, for the way in which it has been edited and produced.

THE ELECTRICIAN ANNUAL TABLES OF ELECTRICITY UNDERTAKINGS. 148 pp. (Benn Bros., 10s. 6d. net.)—It is difficult to say much concerning these well-known tables, now in their 37th year, except that they have again been revised and extended in scope and utility. The revised form of publication introduced several years ago has given general satisfaction, and it has permitted further useful particulars to be added. It is of interest to mention that, although "there is still difficulty in obtaining and verifying data concerning the Colonial and foreign section of the tables"—which, by the way, is rather surprising at this date—yet extended information of upwards of 100 undertakings on the Continent and in the Colonies and other countries abroad has been added in the present issue. The tables have been thoroughly revised, with the exception of some of the Russian undertakings and a few other European ones.

"DAILY CHRONICLE" PHOTOGRAPHIC "HAPPINESS" COMPETITION.

The winner of the three-valve wireless set type M.I.P. manufactured by Siemens Brothers and Co., Ltd., Woolwich, and presented by Siemens and English Electric Lamp Co., Ltd., 38/39, Upper Thames Street, London, E.C.4, is Mr. G. F. Prior, of 9, Lyndhurst Road, Highams Park, E.4. This gentleman first took up photography as a hobby in 1915, and has exhibited at most international exhibitions. In addition, he has secured a large number of photographic honours, the chief amongst them being:—The all-British photographic competition, gold medal and £100; Kodak competition, £50; Vitegas Co.'s competition, £50, etc.; and he is also the holder of a large number of silver and bronze medals.

Photo. by] [Mr. W. H. Reece.

The fact that Mr. G. F. Prior has never interested himself in wireless before makes this gift all the more acceptable, and, after having had the set explained to him, and also the opportunity of "listening-in" to a good concert, he was most enthusiastic in his appreciation of his prize, and is looking forward to spending many happy evenings with his Siemens equipment.

Belfast.—Alderman O. Jamison, in proposing the adoption of the minutes of the Corporation Electricity Committee last week, said he would like to draw the attention of the Council to certain important figures, as showing the efficiency of the harbour power station compared with the best stations in England of a similar class. The figures were extracted from the Electricity Commissioners' Report, Generation of Electricity in Great Britain, 1924. Hackney Borough Council Station was given as the English station with the lowest fuel consumption, and it was very much on the same scale as Belfast. The figure was 2.07 lb. per unit for Hackney, and for Belfast 1.936. That was very significant, because the success of their station depended to a great extent on the low fuel unitage. The station with the highest thermal efficiency across the water was Ayrshire, Kilmarnock, with 15.73 per cent., while the figure for Belfast was 16.7 per cent.

Meetings.—The opening meeting of the Illuminating Engineering Society will be held at the Royal Society of Arts (John Street, Adelphi, London), at 8 p.m. on Tuesday, November 18, when reports will be made on important events during the vacation (World Power Conference, Conference on Illuminating Engineering at Wembley, meeting of International Illumination Commission, International Conference on Industrial Hygiene, etc.) and developments in lamps and lighting appliances, and some interesting novelties (new forms of headlights, reflectors, etc.) will be presented.——The Junior Inst. of Engineers will meet on Friday, 14th inst., at 7 p.m Annual general meeting. Also on Friday, 21st inst., at 7.30 p.m., lecturette, "Stainless Steel," by J. G. Hopcraft (Member), and on Friday, 28th inst., at 6.30 p.m., exhibition of latest scientific instruments and appliances for the use of engineers. All at 39, Victoria St.

Various Items.

Dynamicables' Dinner.—The next dinner of this Association will be held at the Trocadero Restaurant on Tuesday, November 18, at 7.30 p.m.

Cheering News.—The General Electric Co., Ltd., has been advised that the South African Railways have accepted its tender for supplies of Osram lamps for the ensuing 12 months. It is the first time for some years that the bulk of this large and important contract has found its way to an English manufacturer. The contract was lost to this country some years ago, and has since been held by foreign firms. This success of the G.E.C. in recovering trade for Britain is all the more significant when it is realised that they have secured the contract in competition with the whole world.

The E.T.B.I. Annual Festival.—Information has reached us that a very high-class entertainment is being arranged for this function, which takes place at the Trocadero Restaurant, London, on Wednesday, the 19th inst. The services of celebrated theatrical and concert-hall artistes are being acquired, including Mr. Harry Dearth, the noted opera singer. There is every promise of a most entertaining evening, and those desirous of attending should apply for dinner tickets immediately. Applications for these should be made to Mr. F. B. O. Hawes, the hon. secretary, at 98, Grosvenor Road, London, S.W.1.

I.E.E. Scottish Centre.—The 24th annual report of the committee gives details of the meetings which were held in the session 1923-24, and refers with pleasure to an improvement in the attendance as well as in the general discussions. Mr. Alexander Lindsay is chairman for the session 1924-25, and he delivered his inaugural address on Tuesday last, the 11th inst. An informal meeting will be held at the Institute of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, on Tuesday, 25th inst., at 7.30 p.m., when Mr. A. S. McWhirter will deliver a paper on "Design of Modern A.C. and D.C. Motors," and a discussion will follow. The dinner has been fixed for Tuesday, December 16, at the Grosvenor Restaurant, Gordon Street, Glasgow.

The Batti-Wallahs.—An informal meeting of this society will be held at the Engineers' Club on Wednesday, the 26 inst., at 8 p.m., when there will be a mixed (very mixed) entertainment, consisting of several bright vocal items with intervals for conversation interrupted by some deadly serious lectures. Among the subjects to be discussed are "A New Geometry," which will be expounded by Past-President M. S. Chambers, "Sport," which will be gamely tackled by Hon. Sec. M. Whitgift, and a most instructive lecture on "Salesmanship," by Messrs. Hopkins and Wale, who guarantee to sell snowballs to the Esquimaux, glass-cutters on a battleship, and red flannel petticoats to a beauty chorus—and to get repeat orders. Finally, Batti-Wallah W. E. Warrilow will deliver a few new jokes. We might also add that the next luncheon will be on Wednesday, December 10, at the Hotel Cecil, with Vice-Admiral Sir Robt. B. Dixon, Director of Engineering, Admiralty, as the chief guest.

ARMATURE WINDING
and
MOTOR REPAIRS

A.C. Work a Speciality.

Re-designing and re-conditioning of any class of motor.

SAMUEL BAXTER,
Electrical and Mechanical Engineer,
102, GREYHOUND ROAD,
Phone: Hammersmith 2524. LONDON, W.6
Works and Goods Entrance in Crefeld Rd. adjoining.

Vulmos GENUINE VULCANIZED FIBRE
MOSSES & MITCHELL, LTD. 122 & 124 GOLDEN LANE, LONDON, E.C.

Trade Notes.

A new campaign setting forth the advantages of late shop window lighting, has just been launched by the **British Electrical Development Association**, and it is to be hoped that electrical contractors and the trade generally will take full advantage of the booklets and literature which have been prepared by the Association for circulation in connection with this very praiseworthy object. We are glad to hear that quite a large number of suppliers as well as some manufacturers have testified to the extraordinary success of similar campaigns which were carried out in the two past lighting seasons, so there should be no delay in obtaining the necessary literature in order to create the additional trade as quickly as possible.

THE CAMBRIAN ELECTRICAL SCHOOL,
CEMETERY ROAD, PORTH, GLAM.

Principal: WILLIAM THOMAS, M.I.M.E., A. of M.E.E.
Deputy Principal: Dd. I. THOMAS, M.Inst.E., F.R.S.A.
Tutors: Staff of Highly Qualified Instructors in all subjects.

A SCHOOL OF UNEQUALLED REPUTATION. No Branches. No Agents. Influential Employers give preference to Students coached at this Correspondence School.

DO YOU WANT TO SUCCEED?

An efficient Passport to the Best Positions is the Possession of the Electrical Engineering Diploma issued by this School (The C.E.S.) to all diligent Students.
Well-paid and Good Positions await every Successful Student. Commence Now and ensure your Success in Life. Take LESSONS BY POST in Electrical Engineering, Mechanics and Mathematics.

TO ENSURE YOUR SUCCESS AT
ELECTRICAL EXAMS.
STUDY IN PRIVATE AT HOME
WITH THE VERY BEST TUTOR

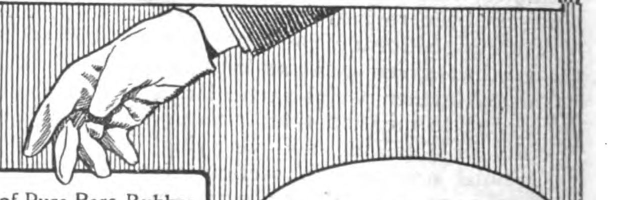
INSTRUCTION UNTIL SUCCESSFUL

Select the Tutor that has an unbroken Record of Successes
At the A. of M.E.E. Exams.
119 *Students passed as* Qualified Electrical Engineers.
At City and Guilds Electrical Engineering Exams.
from 1916 to 1922:—
1,448 students have been successful at the above exams. Such is the record of this well-known school.

To be successful at your next examination, state your requirements, and write to-day for information, free syllabus, and free handbook of exam. questions.

The Secretary (Dept. D), The Cambrian Electrical School, Cemetery Road, PORTH RHONDDA, GLAM.

Sample Pair Sent on Approval for 8/6



Made of Pure Para Rubber, soft and durable and unaffected by climatic conditions
DAVID MOSELEY & SONS, Limited,
ARDWICK, MANCHESTER.

MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

NOVEMBER 21, 1924.

CONTENTS.

PAGE
Three New Shop Window Lighting Units 631
High-grade Steam Pipe Coverings 632
Latest Developments in All-British Fractional Horse-Power Motors 633
A "Matchless" Match Sign 634
Current Topics 637
Electrical Engineering—Grade I. 638
Questions and Answers by Practical Men 639
Our Wireless Corner 639
Correspondence 640
Practical Electrical Engineering Hints 641
South Wales Engineering Exhibition 642
Junior Institution of Engineers 642
Various Items 642

THREE NEW SHOP-WINDOW LIGHTING UNITS.

Shop-window lighting is one of the most difficult and, at the same time, most fascinating branches of illumination work, and probably every illuminating engineer at one stage or another of his career attempts to design a window-lighting unit. On the other hand, experience always tells in the long run, and the British Thomson-Houston Co., who are responsible for the design and manufacture of the three units described below, have been studying the question of window lighting and display lighting generally for a number of years, and have undoubtedly had as wide an experience in this connection as any other British firm. Their X-ray reflectors are well known throughout the country as a highly efficient standard window-lighting equipment, and, in addition, they have developed a number of other special window-lighting units for particular purposes. Three of these —the B.T.-H. shop floodlight, the B.T.-H. spotlight projector, and the Mirolux shop trough—are dealt with in Leaflet L.321, a copy of which has just been received.

The new shop-window floodlight (Fig. 1) is, in effect, a miniature floodlight projector with an adjustable mounting which can be fixed to wall, floor or ceiling.

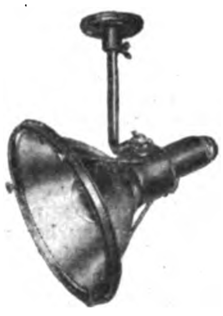


FIG. 1.—B.T.-H. SHOP-WINDOW FLOODLIGHT.

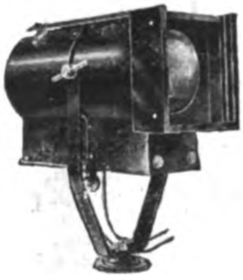


FIG. 2.—B.T.-H. SPOTLIGHT PROJECTOR.

It gives a concentrated beam of light on that portion or feature of the display opposite the centre of the beam, and at the same time provides a lower intensity of illumination over the rest of the window. It is particularly suitable for small shops where up-to-date lighting effects are required, at small expense, from a single adaptable unit. The device can be used to supplement an existing installation, or can be employed alone, and it can be fitted with a colour attachment in order that colour effects may be produced. Two sizes are supplied to take 200-watt and 500-watt regular gasfilled lamps.

The new "spotlight" projector is illustrated in Fig. 2. With it effects can be obtained by using the colour glasses, which are supplied in red, blue, green and amber. The unit is of sturdy construction, well finished, and reliable and efficient in operation. It takes up very little room, measuring 10 in. to 38 in. long by 8½ in. wide, and can be fixed unobtrusively almost anywhere in the window. Two patterns are supplied, one taking a 100-watt lamp and the other a 250-watt lamp.

With regard to the B.T.-H. Mirolux trough (Fig. 3), one of the most interesting features is the spill shield. This consists of a number of louvres or slats, which, while screening the lamps from direct vision, do not interfere with the emission of the reflected light. The form of light distribution is admirably suited to ordinary window conditions, assuring a high intensity from the front of the window (where light is sharply cut off) towards the background. The trough is standarised and stocked in three- and four-light sections, with lampholders spaced on 9-in. centres.

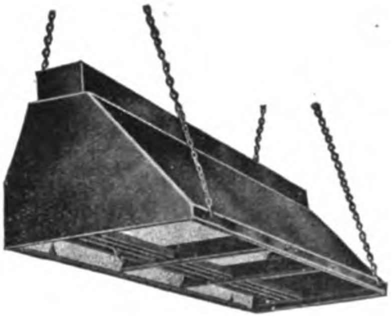


FIG. 3.—B.T.-H. MIROLUX SHOP TROUGH.

A small window could be lighted entirely by means of the shop-window floodlight, although the unit is really intended as an accessory to the general lighting; but the spotlight projector is definitely intended and is only suitable for the "spotting" of particular articles, while the Mirolux shop trough is designed for the general illumination of windows of all sizes. The ideal arrangement is a combination of all three units, with a full equipment of colour slides. Thus, one might have a window in which the general lighting was white, while a certain area or group of articles was bathed in, say, blue illumination from the floodlight, and the central feature picked out in red or amber by means of the spotlight. Either the floodlight or the spotlight, or both, could be wired on a flasher, which would still further enhance the spectacular appearance of the display.

Engineer readers who are interested in display lighting are advised to write to the British Thomson-

Houston Co., Ltd., for copies of Leaflet L.321 (Fig. 4), which is folded in such a way that it may be sent through the post without an envelope; while retailers are invited to apply for quantities overprinted with their names and addresses. The leaflets, when received by them, will only require addressing and stamping. They can then be mailed without a covering letter or envelope to their mailing list.

FIG. 4.—NEW B.T.-H. SHOP-WINDOW LIGHTING LEAFLET NO. L.321.
(This leaflet is folded for mailing without an envelope.)

HIGH-GRADE STEAM PIPE COVERINGS.

THE VALUE OF BLUE ASBESTOS.

The remarkable increase in steam pressures during only this last five years in connection with power station work has brought in its train all kinds of problems for solution. It is not so long ago that what could be termed standard high-class station practice was 200 lb. pressure and 600 degrees F. steam temperature, and most of the stations of the world still operate at or below these figures. To-day, however, 350 lb. pressure and 700 degrees F. is regarded as normal for super-stations, but already one station in England (North Tees) is operating at 450 lb., and the new Crawford Avenue station in Chicago will be 550 lb., whilst the tendency is towards 750 degrees F. superheat temperature.

One of the resulting problems is that of boiler and pipe coverings, and whilst a number of so-called high-class coverings were in reality never very suitable for 600 degrees F., the matter becomes hopeless at 700 degrees F. Thus, for example, even magnesia (hydrated magnesium carbonate) has been shown by a recent report of the National Physical Laboratory to show distinct signs of decomposition at as low as 450 degrees F.

As a result, in most cases it has been found necessary to put on the pipe first some kind of composition, generally half an inch thick, whose merit is not so much that of a non-conductor as to take the first shock of the heat and try and protect the covering proper which is laid on the top, often followed by still a third layer of hard-setting material to bind the whole of the pipe.

For modern power station conditions pure blue asbestos fibre, made up in segments ready to fasten direct on the pipe, possesses strong claims to be almost the ideal material. In the first place, as shown by the National Physical Laboratory tests, it is one of the best non-conductors of heat known, being 20 per cent. more effective than white asbestos and saving 91-94 per cent. of the heat radiated from a bare pipe at a very high temperature of 800 degrees F., whilst, of equal importance, it will stand this temperature indefinitely without any deterioration, either in non-conductive or mechanical properties. Thus the material continues to retain its strong fibrous condition and consequently there is no trouble, especially in the case of pipes subject to vibration, by the covering being slowly disintegrated and gradually shaken down to the underside of the pipe, leaving the topmost portion partially exposed. Many otherwise excellent coverings suffer from this defect, especially at temperatures of 600 degrees F. and over.

The life of the material up to 800 degrees F. is as yet unknown, although quite a number of jobs at high temperatures have been in operation for fifteen years with no sign of deterioration. One of the best indications of its extraordinary resistant properties to heat is that when subjected to the action of a blowpipe flame in the laboratory the loss in weight is only about 4½ per cent. Under these conditions even the best quality white asbestos loses 15 per cent., and the ordinary good-class composition is simply shrivelled up. Blue asbestos or crocidolite differs from the more common white asbestos (chrysolite) in being deep lavender blue in colour and having a much higher percentage of iron, whilst the magnesia and water content is lower. It is found in South Africa and was originally introduced on the market by the Cape Asbestos Co., Ltd. (Guildhall Annexe, 23, King Street, London, E.C.2), who have their own mines at Griqualand and have made a speciality of its application in addition to their ordinary business in connection with white asbestos.

Further advantages of blue asbestos are that it is longer in the fibre and is less in specific gravity, an important point since the weight of the pipe is reduced. In addition, it is not affected by acids, most chemical solutions, or sea water. The material is supplied in many different forms, as blankets, mattresses, in the plaited or twisted condition, and, above all, as moulded pipe segments, normally about 3 ft. long and of any diameter. These are split in the centre and are merely opened and fastened round the pipe in any convenient manner by canvas, metal bands, or sheet metal, if in the open air.

For flanges it is either used as a special shaped mattress with hooks, or packed loose in metal flange boxes, and no matter how badly a joint may leak the material, because of its fibrous condition, is not blown out of the box, but simply becomes saturated with water and dries itself again when the joint is repaired.

India.—The report on some aspects of British trade in India to June, 1924, has just been issued by the D.O.T., and may be obtained from H.M. Stationery Office or ELECTRICITY Office, price 3s. 4d. net post free. It is a bulky volume of 220 pages, containing a large amount of statistical data and information which will interest all branches of the commercial world in Great Britain. From the point of view of the electrical industry, pages 157-158 contain details showing the important position held by Great Britain in supplying the goods which come under the heading of instruments, apparatus, appliances, etc., and of which electrical apparatus accounts for the greater portion. Apparently the United Kingdom has been improving her position decidedly in various directions during the last few years, and this should be very satisfactory from the point of view of manufacturers of electrical supplies. It is, however, essential that the market should be cultivated most carefully, and every endeavour made to increase still further the exports of our home-made goods.

LATEST DEVELOPMENTS IN ALL-BRITISH FRACTIONAL HORSE-POWER MOTORS.

It has often been alleged in the past that British manufacturers, excellent though their products might be in other directions, failed to take full advantage of the possibilities of mass production and standardisation in design. This allegation can certainly be made no longer so far as fractional horse-power motors are concerned, for in the Wilson-Wolf electric motors, which we were recently privileged to inspect at the showrooms of Messrs. Pooley and Austin, 34, Broadway, Westminster, S.W. 1, we have "all-British" machines of the highest possible excellence, bearing witness to most careful design in every respect, and fulfilling every possible requirement in the way of combined standardisation and flexibility. It is not surprising to learn that these motors have been adopted as standard equipment by the makers of a great variety of machines requiring anything from 1-40th to ¾ h.p. to drive them. How great is the variety of these applications, and how high the standing of the firms who have adopted the Wilson-Wolf motors, may be gleaned from the public exhibition of typical equipments arranged by Messrs. Pooley and Austin at the address mentioned above. Though the motors themselves are always to be seen in these showrooms, the special display of machines embodying the motors in dozens of different ways has only been made possible by the co-operation of the firms making the apparatus concerned, and we strongly urge our readers to take advantage of this exceptional opportunity of seeing what can be done in the way of direct and indirect driving by small electric motors. Many of the mountings shown are extraordinarily ingenious and efficient.

The Wilson-Wolf motors are made with three standard sizes of carcase, giving outputs from 1-40th to ¾ h.p. according to the winding and speed; the latter may be anything from 400 to 6,000 r.p.m., or even higher. The two smaller types of motor have laminated fields and can be used, when series wound, on either direct or single-phase alternating current supply; also, they can be either shunt or compound wound for direct current supply. The largest, or C-type, motor is built *to the same dimensions* for either direct current or for single, two, or three-phase supply. Thus, whichever type of motor be required for driving a particular machine, the user can standardise upon that type and make exactly the same provision on all his machines, whether the motor itself has to be operated on direct or alternating current supply.

This, in itself, is obviously a most important advantage, but the standardisation of the Wilson-Wolf motors goes much further—but without hampering the user in any way, for the same motor can be used in any position by aid of a few simple features of its construction which meet all requirements.

For example, in the smaller types of these motors, with laminated fields, the latter are enclosed by an aluminium casing ring which may be either plain or cast with a mounting foot, one type of ring being changed for the other as required by removing one end cover and slipping off the ring. The largest type of motor is provided with a bolted-on foot when required, and the end plates are tapped so that the machine can be attached to a vertical mounting if desired.

The bearings of the "Universal" (D.C. and A.C.) motors are of an entirely new pattern. They are of a patent self-aligning, self-oiling type; and they can be removed in a moment and contain sufficient oil for six month's running. A die-casting of white metal forms the bearing itself, and special grooves in the end cover and oil-throwing rings on the motor shaft make it impossible for oil to reach the windings whatever the position of the motor. By a simple but ingenious device the oil holes of the bearings can always be kept uppermost, whether the machine be upright, inverted, or inclined; this is secured by arranging the end covers to engage with any one of eight notches in the field of the motor. The largest type of these motors (C-type) with ball bearings can be used either as a horizontal or as a vertical machine, the ball bearings being designed to take end-thrust as well as radial load.

Another interesting feature is that, although die-castings are used wherever applicable in these motors, the accuracy of the castings is not relied upon for assembly. Perfect interchangeability is ensured by taking a very light machine cut over the seatings.

The brush gear, a vital point in every electric motor, leaves nothing to be desired in the Wilson-Wolf machines. The connecting screws are extremely accessible, and the brushes themselves are removed in a moment by unscrewing a cover disc. The removal of the latter does not, however, allow the brush to fly across the room; this is prevented by a disc on the spring engaging lightly with the screw thread; a touch with the screwdriver releases it after the cover is removed.

Yet another point of interest in these motors is that the laminations for the stator and armature core, in the case of the "Universal" machines, are stamped from the same blank. The almost incredibly small piece of waste consists of a complete ring of metal, the thickness of the laminations and the width of the air gap, carrying the pieces of metal stamped out to form the winding slots! To our mind this remarkable piece of scrap is unique evidence of excellence, efficiency and economy in design and manufacture. The armature core slots, it may be added, are narrower at the bottom than at the top, so that the tooth section is uniform throughout, and the slots are skewed with regard to the axis so that there may be no tendency to magnetic locking of the rotor.

Needless to say the windings are excellently insulated and supported, and the same carcase can be fitted with any one of a number of patterns of end-covers according to the degree of enclosure required. The rating of the motors is, of course, reduced by complete enclosure, but it is at all times in conformity with the latest B.E.S.A. specification on the subject (No. 168). Whereas most of the fractional horse-power motors on the market are rated high, run hot in service, and can carry little or no sustained overload, the Wilson-Wolf machines are guaranteed to carry 25 per cent. overload for one hour, and 50 per cent. overload for short periods without undue rise in temperature; actually they will carry much heavier loads with safety. As a result, a Wilson-Wolf motor will give better service than a less conservatively rated machine of considerably higher nominal power.

As a case in point, we may mention that a ⅛ b.h.p. Wilson-Wolf shunt wound motor is used to operate, through reduction gear, a heavy cinema curtain and light-dimming switch. Formerly a 1 h.p. motor was used for the purpose, and the inertia of this large machine caused trouble by over-shooting of the curtain. The $\frac{1}{8}$ h.p. Wilson-Wolf motor carries the load perfectly and stops dead on the desired positions.

Amongst the many other applications of these motors on view at the above-mentioned exhibition we were particularly struck by the use of a $\frac{1}{4}$ h.p. direct current compound wound motor, with suspension-type end cover, for driving a flexible shaft terminating in a special tool-holder. The motor can be hung from any convenient hook, and the tool-holder can be fitted with a screwdriver, drill or other tool. Though the flexible shaft be running the tool-holder is not set in motion until pressure is applied to the tool, and it slips automatically if the load be excessive. This equipment is of extraordinary utility in any workshop.

The well-known Creed printing telegraph apparatus is now standardised with Wilson-Wolf motors for driving. The perforator is driven by a belt-coupled 1-30th h.p. shunt wound machine of the standard horizontal type with self-oiling, self-aligning bearings, which machine will run in any position. The tape transmitter is driven by friction disc from a similar motor (supplied, however, without feet), and the tape receiver is direct coupled to a $\frac{1}{8}$ h.p. shunt wound motor which is wound specially so that it maintains constant speed over a long period. The speed of standard shunt wound motors is, of course, liable to rise appreciably owing to the increase in resistance of the field winding as it becomes hot.

The use of Wilson-Wolf motors in conjunction with high ratio (250 to 1, or even 1,000 to 1) reduction gear of the ball-driven epicyclic type, offers a convenient means of securing a very slow, low power drive. The efficiency of these remarkable reduction gears is as high as 97 per cent. and they can be used with almost equal efficiency as step-up gears!

Did space permit we could describe many other applications of these motors, including, for example, coffee mills, rotary duplicators, adddessing machines, lathes, forge blowers, self-propelling bath chairs (driven efficiently by a $\frac{1}{4}$ h.p. motor!), centrifuges, and so on. Enough has been said, however, to demonstrate the merits of this interesting line of machines. We have been particularly impressed by the manner in which designer and manufacturer have co-operated to secure the best results at minimum cost in every component. Also, and this is very important, the motors are not merely a combination of good details, but smooth and sound machines in which every part suits all the others. Yet some of these parts are provided in different, but interchangeable, patterns, so that all needs can be met and the maker of any low-power machine can rely upon the Wilson-Wolf motors to meet his requirements and blend into his machine without demanding alterations or imposing limitations. Finally, the Wilson-Wolf motors are all-British from start to finish.

A "MATCHLESS" MATCH SIGN.

The term "Brighter London" has in the past only been associated with the West End. A bright spot, however, has recently appeared in the East End, where Boro' Electric Signs have erected for Messrs. Bryant and May a huge electric sign, 165 ft. long by 7 ft. 6 in. high, overlooking the L. and N.E. Railway main line at Old Ford Road, Bow.

It is erected on the canal side of the wharf, which is 25 ft. below the level of the railway, and in order to bring the sign on a level with the passing trains a special structure 35 ft. high was erected as shown in Fig. 1. In order to occupy only a minimum amount of stacking space it was decided to use ferro-concrete columns, and these, of which there are ten, each weigh approximately two tons, while the total weight of the ironwork supporting the sign is over three tons. The letters in the sign itself are 4 ft. high, and are illuminated by 636 20-watt Daylight Blue sign type Osram lamps. A further 1,272 orange-sprayed 20-watt lamps are fitted in the border, making a total of nearly 2,000 lamps.

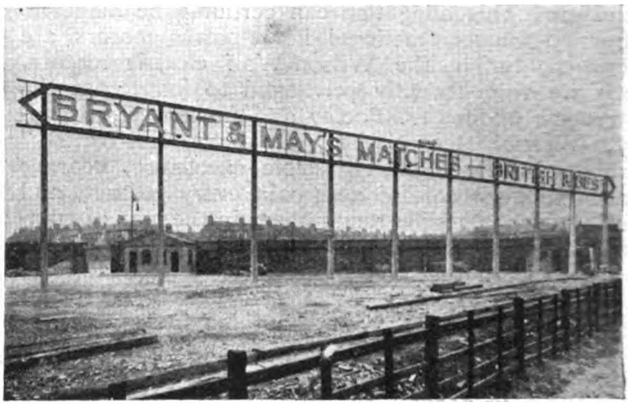


FIG. 1.

The operating mechanism is contained in a special brick-built house, and the night effect as viewed from the passing trains is shown in Fig. 2. Careful arrangements have been made to ensure a balance of the load on the supply mains of the Poplar Borough Council, and the sign, both by night and day, forms a landmark which dominates the whole district. It is probably more effective as a publicity medium than would be a similar sign erected in the heart of the West End, since countless numbers of passengers arrive at, and depart from, Liverpool Street Station each week.

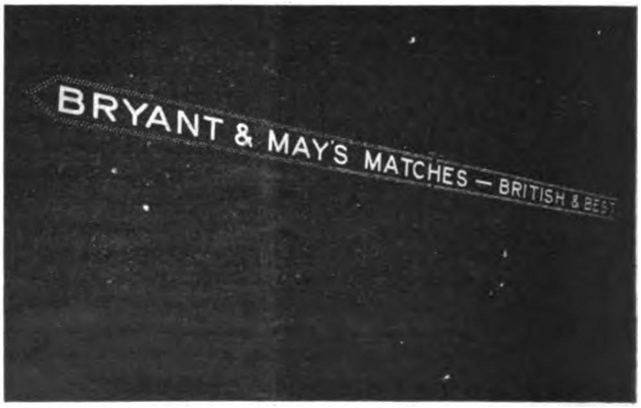
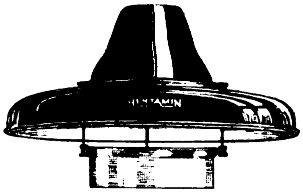


FIG. 2.

Every man believes he could make a fortune on the Stock Exchange if he only had a little capital to start with.

Brilliant Light Without Glare
The BENJAMIN BIFLECTOR



The latest contribution to scientific illumination.

Ideal for Spinning Frames, Weaving Looms, Compositors' Frames, Offices, Schoolrooms, Hospitals, etc., etc.

Advt. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription : 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited, and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL & CO., LTD., 36-39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

Gas Lighting for Trains.

Although the terrible railway disaster to the Liverpool-Blackpool express had not the usual accompaniment of fire directly due to damaged gas cylinders and escaping gas, I understand that one or more of the coaches were thus equipped, a fact which indicates that the railway companies have not yet completed the urgent task of converting all passenger rolling-stock to electric lighting. It will be remembered that France took the lead in this matter some time ago by setting a limit to the period in which all such conversions were to be effected. No doubt the British railway authorities are doing their best to expedite matters, but it would appear desirable for the Ministry of Transport to lay down some regulation as to time limit beyond which the gas lighting of passenger coaches will become illegal, otherwise we shall be hearing of further disasters in which liberated and ignited gas contributes to the horrors of the accident.

So far as we are aware there is no serious obstacle in the way of completing the conversion of all those passenger coaches which are at present lit by gas. Train lighting systems relying on electricity as the illuminant have been brought to a high pitch of perfection, and there can be no two opinions as to the improved quality of the illumination afforded by the electrical method. Most travellers are accustomed to while away long railway journeys by reading, and the strain upon the eyesight through endeavouring to decipher small print with the aid of the miserable glimmer afforded by the average roof gas lamp must be considerable. Thus, quite apart from the question of safety in case of collision or derailment, there is the secondary argument in favour of electric lighting. Speaking personally, I always select an electrically-lit coach in preference to one illuminated by the older method whenever there is a choice, as sometimes happens on a composite train, and I have no doubt other experienced travellers do likewise.

Prolonged Storage.

It would be extremely interesting to know how long the average accumulator or storage battery is capable of retaining its original charge without appreciable loss. In the majority of instances a battery is kept working more or less continuously, and the discharge follows almost immediately on the completion of the charge. There are, nevertheless, numerous cases in which storage batteries are not used immediately after charging, but are required for service a week or month, or even longer, after charging, and in such cases the faculty of retaining the charge for lengthy periods without appreciable loss is vitally important. There are two main causes for loss of charge on open circuit, viz., local action and leakage. In lead-acid accumulators the losses due to both are appreciable, owing to the nature of the electrolyte and the chemical and electrochemical changes which are continually taking place within the cell.

In the nickel-iron class of storage battery, on the other hand, there is no local action, and given reasonable insulation in mounting the cells, no appreciable leakage either. I know of two batteries of this class, one a Ni-Fe combination of small ampere-hour capacity, the other an Edison; neither of which have been recharged for over seven months, but which still show their original voltage and apparently retain the last charge given them in the early spring. From this it would appear that wherever a storage battery is required to retain its charge for lengthy periods without undue loss, the nickel-iron alkaline type should be selected in preference to the lead-acid battery.

Politics and Power.

In an address delivered before the Westinghouse Club, Wilkinsburg, Pa., by Guy E. Tripp, LL.D., Chairman of the Board of the Westinghouse Electric and Manufacturing Co., he treats of the important relationship between super-power, as we have come to know it since the war, and politics. According to Mr. Tripp, super-power is something more than the mere inter-connection of existing light and power systems. It means, in addition, the creation of new 220,000 volt transmission lines, themselves inter-connected, which will perform a service impossible of attainment by local inter-connection. But the inter-connection of local systems is a preliminary step to super-power development, and we are without doubt in the midst of a great revolution of the light and power business. This revolution began with the war, because the war speeded up this development, which might have come in the ordinary course of things, but probably many years later.

Touching on Government ownership of super-power stations, Mr. Tripp claims that not even the most hearty advocate of Government ownership in the United States has, or can, claim that private enterprise is not doing development work in a most satisfactory manner. The American power industry is conceded by everyone to be highly progressive, and has, in fact, regularly anticipated the growth of the country.

Especially is this true of super-power development. Super-power systems were well advanced in process of formation in several sections of the United States before legislators and the Press even knew the meaning of the term, and they are to-day expanding with a rapidity that is literally astonishing the populace. Government ownership is therefore unnecessary to electrical development in the United States.

In Mr. Tripp's address considerable reference is made to the Lloyd George Report on Coal and Power, and stress is laid upon the dictum that the provision of more and cheaper electric power in all our chief industrial centres will materially increase the individual earning power of our workers without necessitating greater individual effort than is now expended by them on out-of-date and inefficient processes. It will be recalled that in the Lloyd George Report, economic studies showed that in the United States a workman is furnished, on the average, with rather more than twice the power with which the British workman is furnished, whilst in the relation of power to wages it was also shown that on an average the New York worker receives 2½ times as much wages, expressed in terms of purchasing power, as the London worker. The conclusion is drawn that, the more power at a workman's disposal, the greater will be his output and the higher will be his wages, while at the same time the lower will be the cost and the market price of the units he produces.

Summarising, Mr. Tripp's contention is that electrical development in both this country and the United States is best accomplished by private enterprise under proper Government control and regulation. He further adds, by way of conclusion, that in Great Britain a vast accumulation of special privileges places exasperating restrictions on the mining of coal, the development of water power, and even the extension of electric power systems by anyone. The British Government will have to obtain special powers in order to wipe away these privileges and thus facilitate private enterprise. That such powers are urgently needed would appear evident from the recent report of the Electrical Commissioners in regard to obstacles encountered by them in their endeavours to speed up development in this country. This is a matter which might well and profitably receive the early attention of the new Government.

ELEKTRON.

Messrs. Constable's monthly list for November gives details of various new books which have been published by this well-known firm, as well as of those which will be ready shortly, including the new edition of *Diesel Engine Design*, by Purday. The list should certainly be in the hands of every book-lover.

Forthcoming Book.—Messrs. Ernest Benn announce "Radio: Beam and Broadcast, its Story and Patents," by A. H. Morse, the late managing-director of Marconi Co. of Canada. The author provides the first critical and constructive history of the development of wireless, paying particular attention to relevant British and American patents. Those portions of the book which deal with the past, present and future of beam telephony and telegraphy are of the greatest topical importance, and should cause more than a little discussion, and possibly controversy. The book will be fully illustrated, and should be an important work of reference for all practical radio engineers as well as a valuable guide for students and inventors. It will be published early in the New Year.

ELECTRICAL ENGINEERING—GRADE I.*

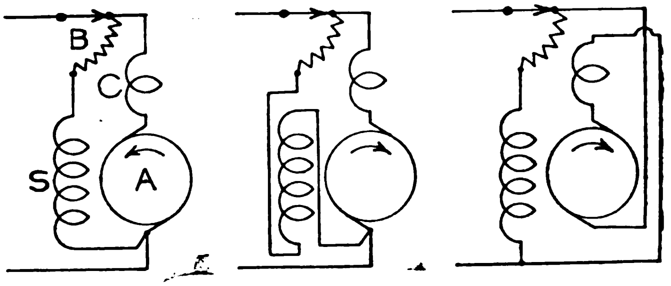
Solutions to 1924 Examination Questions of the City and Guilds Institute.

BY EDWARD HUGHES, B.Sc. (Eng.), A.M.I.E.E.

(*Continued from page* 626.)

Q. 11.—Draw diagrams showing the alterations in connections which must be made when the direction of rotation in (*a*) a shunt, (*b*) a series, (*c*) a compound-wound motor, is to be reversed. What alteration of brush position might be necessary?

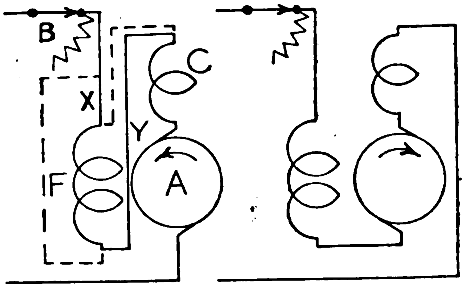
A. 11.—(*a*) *Shunt motor.*—Fig. 6*a* shows the shunt-motor connections before any alterations are made, *A* being the armature, *S* the field, *C* the commutating-pole winding (if any) and *B* the starter. The direction of rotation is reversed by reversing either the field or the armature current. It is simply a case of looking at the leads of the particular machine involved and deciding which is the simpler operation. Fig. 6 *b* shows the connections with the shunt reversed, whilst Fig. 6 *c* shows the machine with the armature connection reversed. If the brush leads are long enough, the latter alteration can be made by simply shifting the brush-gear through approximately a pole-pitch. Should the machine be fitted with commutating-poles, however, the shifting of the brushes must be accompanied by a reversal of the C.P. winding.



(*a*) (*b*) (*c*)

FIG. 6.

An alteration in the brush position may be necessary after reversing the direction of rotation—especially



(*a*) (*b*)

FIG. 7.

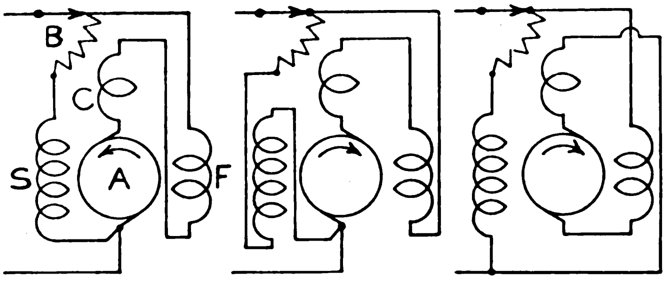
---

* Books recommended are *Elements of Electrotechnics*, by Young (7s. 10d. post free), and *Technical Electricity*, by Davidge and Hutchinson (13s post free), both from S. Rentell and Co., Ltd., 36, Maiden Lane, London, W.C 2.

in the case of non-interpolar motors. To obtain the best commutation with such machines, the brushes have to be shifted backwards relatively to the geometric neutral. Consequently, when the rotation is reversed, the brushes must be shifted to the other side of the neutral in order to obtain equally good commutation. In the case of interpolar motors, the brushes are generally in the neutral so that readjustment is seldom necessary.

These remarks concerning the brush position also apply to series and compound motors.

(*b*) *Series motor.*—The full lines in Fig. 7*a* show the connections of a series motor before any changes are made. The dotted lines indicate the alterations to *X* and *Y* necessary to reverse the field winding, whilst the connections for a reversed armature winding are given in Fig. 7*b*.



(a) (b) (c)

FIG. 8.

(*c*) *Compound motor.*—Fig. 8*a* shows the initial connections of a compound motor, *S* being the shunt and *F* the series winding. Both *S* and *F* must be reversed in order to reverse the magnetic field, the new connections being indicated in Fig. 8*b*. Fig. 8*c* gives the connections for reversing the armature current.

(*To be continued.*)

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at he top left-hand corner of all letters intended for this column.

QUESTION NO. 191.

How can I convert my crystal receiving set into a one-valve set with a minimum expense?—"ASTATIC."

QUESTION NO. 192.

In the plant at our colliery, our motor load is running at .6 power factor. How can I improve this? Would it be better to improve this to unity power factor or to some value below unity?—"A. F. JAMES."

(*Replies to Questions Nos.* 191 *and* 192 *must be received not later than November* 29, 1924.)

Our Wireless Corner.

ROMANCE IN WIRELESS.

A number of the original employees of the Mullard Radio Valve Co. were present at a dinner given by the company in London on Friday last, to commemorate the fact that five years ago Mr. Mullard, with their help, started to make radio valves at Southfields. To-day the Mullard Radio Valve Co. employ 500 employees, and have clients in nearly every part of the world. During the evening a telegram was read by Mr. Owens, the secretary of the company, from Mr. S. R. Mullard, managing director, stating how sorry he was that owing to illness he was unable to be present, but thanking them all for the way in which they had worked with him during the last five years in making the business what it was to-day, the largest firm of radio valve manufacturers in the world. After dinner the company adjourned to the Palace Theatre to see the "Co-optimists," whose performance was enjoyed by all; in fact, the whole evening's pleasure and entertainment was unanimously voted A1.

SHIP'S ORCHESTRA "BROADCAST."

A "ship's orchestra repeater," designed to enable music played in a saloon to be heard in other parts of the ship, has been developed by the Marconi Company, and the first ship to be fitted therewith is the C.P.O.S. liner *Montclare*, running from Liverpool to Canada. The installation comprises a Marconiphone and loudspeaker, and the quality of reproduction is so high that it is possible to give an exact imitation of an orchestra both in regard to the volume of sound and musical quality. Orchestral music can thus be repeated in any part of the ship, and it will be especially popular as a means of providing dancing on various decks. The installation will not only be available for the reproduction of music, but also for lectures, concerts, or any other purpose for which simultaneous hearing might be useful on board ship.

B.T.-H. RADIO VALVES.

B.T.-H. radio valves are the result of many years experience in high vacuum work, and it is claimed that they are produced by the most up-to-date machinery in the world. They are very highly exhausted by a special process developed in the valve factory, and consequently are dead "hard." There are six different types and each is unequalled in its class.

These six valves are classified under two main heads —" general purpose " and " power amplifying." The former are *real* general purpose valves, and each of the three types functions equally well as detector or H.F. or L.F. amplifier. The "general purpose" valves are the R. valve, which is a bright-emitter, taking 0.7 amps. at 4 volts on the filament, and a maximum of 100 volts on the plate; the B.3 valve, which is a dull emitter of great durability, taking 0.35 amps. at

1.8 volts on the filament and with a plate voltage of 80 volts; and the famous B.5 valve, having a filament current of 0.06 amps. at 3 volts and a plate voltage of 80 volts.

The three power-amplying valves are the B.4, which takes 0.25 amps. at 6 volts; the B.6 valve, which takes 0.12 amps. at 3 volts; and the B.7 valve, which takes 0.06 amps. at 6 volts. The maximum plate voltage for these power-amplifying valves is 120 volts in each case.

We hope to have the opportunity of testing and notifying the special features of some of these valves at a later date.

DEVELOPMENT OF LONG AND SHORT WAVE WIRELESS SIGNALLING SYSTEMS.

At a meeting of the Institute of Engineering Inspection, held at the Royal Society of Arts, on Thursday, the 13th inst., a paper was read by Mr. A. P. Welch on the above subject, and the main features governing the principles of radio transmission were dealt with and traced from their inception in the very early days of electrical pioneering dating from 1892, when oscillatory currents were experimented with by Elihu Thomson, to those in operation and still being developed at the present day. Interesting lantern slides were shown, and the author of the paper briefly described many of the details of apparata connected with installations now in use for commercial purposes, and he also touched upon some of the possibilities which may be looked for as the latest type of focussing beam system comes more into prominence and operation; in connection with which it would appear that the "short wave" transmission possesses considerable advantages over "long wave."

The immensity of the field for research and experiment is, however, so vast, and the areas of scientific theories so complex, many of them as yet waiting further exploration and confirmation, that it is only possible to regard as but the merest fringe of actual knowledge. The conclusions already arrived at and decided by the greater authorities in such matters of our day were clearly expounded. Among them were quoted such names as Sir William Preece, Sir Oliver Lodge, Dr. Fleming, Dr. Fordsen, Mr. Diddel and Signor Marconi, as well as others who had devoted months and years of their lives to the development of the practical and commercial use of this science.

NEW LITERATURE.

We have received three further leaflets from the Marconi Company:—

Leaflet No. 1,040 is supplementary to Pamphlet No. 228, and deals with Marconi open aerial receivers, types R.G.5 and R.G.5A. The only difference between the two sets lies in the number of stages of high-frequency and low-frequency amplification employed. The former embodies a nine-valve amplifier, and the latter a six-valve amplifier. The R.G.5 model gives the greatest sensitiveness that can be practically handled in any receiver of this type. In accordance with their standard practice, the anti-capacity valves of the V.24 type are used. The tuning circuits are suitable for spark, tonic train, telephony, or continuous wave signals, but in the latter case a local oscillation generator must be included, as no provision is made for auto-heterodyne reception. A coupled receiver circuit is used with a "tune stand-bi" position.

Leaflet No. 1,028 describes and illustrates in some detail the Marconi 15-kilowatt type "U" transmitter, gives general data of uses, range, wave-length, power supply, etc., together with a technical description and details as to the type of valves used, filament and anode voltage, aerial current, etc. Like all other Marconi publications, the illustrations convey an excellent idea of the apparatus and its design.

Leaflet No. 1,035 illustrates and describes Marconi 500-watt portable and semi-portable transmitting and receiving stations. These are designed primarily to fulfil military requirements for a mobile wireless equipment, and are adapted for permanent or temporary installation in cars or motor lorries. They may also be used for point-to-point telegraph or telephone service of a more or less intermittent character. The compactness and simplicity of the apparatus, and the fact that it can be independent of any outside source of electrical power, makes it particularly suitable for such purposes. Three types of station are described, types Y.C.3, Y.C.4, and Z.C.2, the input power in each case being approximately 500 watts. The leaflet in question gives full technical details, and is amply illustrated.

An excellent 84 pp. catalogue of wireless sets and parts has just been issued by the Sun Electrical Co., of 118, Charing Cross Road, London, W.C.2. It is very comprehensive and is also profusely illustrated, as well as giving prices of the latest and best types of supplies in the wireless world, so it should most certainly appeal to every radio retailer. Any trade reader who has not already received a copy may obtain one on writing to the company on his business letter heading.

Correspondence.

To the Editor of ELECTRICITY.

DEAR SIR,—With reference to the circular letter and booklet and sample being sent out by Messrs. Simplex Conduits, Ltd., of Birmingham, the process by which the conduits are "zinc impregnated rust-proof" is "Sherardizing" or vapour-galvanising, which is now being applied in this country for a large variety of purposes. It is a large industry in America, one plant alone treating over a hundred tons a day; the Sherardized electric conduit is also an important industry in America, being known as "Sheraduct."—Yours truly,

SHERARD COWPER-COLES.

Nov. 13, 1924.

Leaflet No. 45/1-1 has just been issued by the **Metropolitan-Vickers Electrical Co.**, of Trafford Park, Manchester. It describes the "Vickcen" Centrifugal Separator, which is entirely of British design and manufacture, and is positive, rapid and efficient in cleaning oils of all kinds, whether insulating, lubricating, or fuel. No blotter sheets or other filtering media are used, and the centrifugal action of the separator, being many thousand times stronger than gravity, separates instantaneously finely divided impurities that might not settle out by gravity in many hours of complete rest. The separator is equally effective ashore or afloat, being undisturbed by the ship's motion. Switchgear and transformer oils can be quickly and cheaply freed from water and sludge, and the separator should be an important adjunct in every large power station. There are numerous other applications in which the "Vickcen" Separator will be found useful.

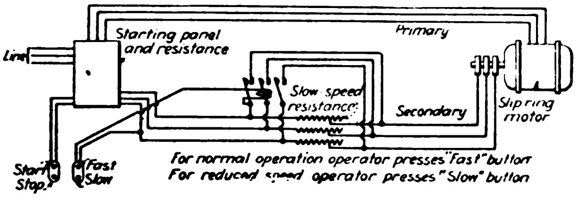
Practical Electrical Engineering Hints.

We cordially invite all our readers to contribute to this interesting and useful feature. All hints received will be given careful consideration and will be paid for at our usual rates.—THE EDITOR.

NO. 20.—HOW THE SPEED OF A SLIP-RING MOTOR WAS REGULATED WITH A RESISTANCE.

It was found to be desirable to slow down the speed of a slip-ring motor of 15 h.p. with remote control; the starting resistance was designed for starting only.

A fixed resistance was placed in the secondary leads near the motor; the resistance was shunted with a switch. The latter was a three-pole magnetic switch operated with push-button control at the same time as the starting control. The motor was started with the resistance in the secondary circuit for the slow speed, and when a higher speed was desired the button marked "Fast" was pressed and this shunted out the resistance.

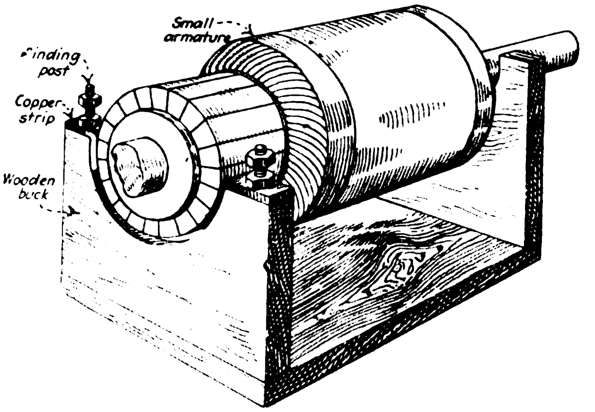

Line
Starting panel and resistance
Primary
Slow speed resistance
Secondary
Slip ring motor
Start
Stop
Fast
Slow
For normal operation operator presses "Fast" button
For reduced speed operator presses "Slow" button

Speed regulation could have been obtained by inserting resistances in two of the three phases, but this would have drawn unbalanced currents from the line on slow speed. The arrangement shown in the diagram worked very well and is giving satisfaction.

A. L. M.

NO. 21.—HOW A SUPPORT FOR BAR-TO-BAR TESTS ON SMALL ARMATURES WAS MADE.

When dealing with small armatures it is often difficult to apply a bar-to-bar test for damaged coils and reversed connections. For making such a test easy in our winding-shop, a small trestle, just the size for the armature to be tested, was made, with one upright cut out to fit the commutator instead of the shaft.



The upright was fitted with two strips of copper as shown in the sketch. In this way, when the armature was placed in the "buck," the commutator made contact with these strips at two points directly opposite each other.

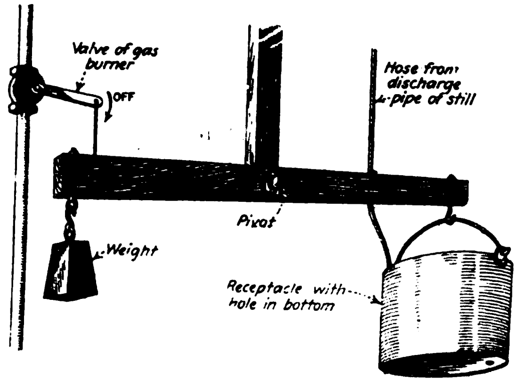
The direct current lines were attached to these strips by means of the binding screws, an arrangement which allows the bar-to-bar test to be made by merely turning the armature and touching adjacent bars at the top point of the armature with the leads of a milli-voltmeter in the usual manner.

F. S.

NO. 22.—HOW THE BURN-OUT OF A BATTERY WATER STILL WAS PREVENTED.

To prevent the burn-out of a still, used for distilling water for accumulators, it is necessary for the heat to be cut off when the cooling water supply fails. An automatic method for turning out the gas on failures of the water prevents such burn-outs in our charging-shed.

The device is shown in the sketch, which illustrates a weight hung to an arm, which is connected by a wire to the valve on the gas burner. The weight tends to turn the valve to the "off" position.


Valve of gas burner
OFF
Hose from discharge pipe of still
Pivot
Weight
Receptacle with hole in bottom

The bar is about 4 ft. long and it is pivoted in the middle, the other end hanging over a small vessel into which the discharged cooling water flows. This vessel has a hole in the bottom through which the water runs. This hole, however, is of such a size that the vessel is always full while the water is discharging in the right quantity.

The weight of this water counterbalances the iron weight on the other end of the beam. In case, however, the water ceases to flow from the discharge pipe, the vessel becomes empty and the weight closes the valve of the burner. It must be said for the efficiency of this arrangement that before it was installed burn-outs were a frequent occurrence. Since it has been fitted, however, there has been no more such trouble.

A. SHANNEN.

Tenders Accepted.—The G.E. Co. have obtained a large contract for the supply of special types of Robertson Carbon Tubular Lamps to the Admiralty.

SOUTH WALES ENGINEERING EXHIBITION.

This exhibition, which is being held at Cardiff, under the auspices of the South Wales Institute of Engineers, will be opened by the Lord Mayor of Cardiff, on Thursday next, the 27th inst., and remain open until December 6. It will be held at the Drill Hall, Dumfries Place, and in addition to the reading of various papers of direct electrical and engineering interest, there will be cinema films and slides demonstrating coal cutters and other machines in actual operation, as well as a series of popular demonstration lectures on "Modern Electric Lighting," by Mr. W. E. Bush, the well-known manager of the Elma Lighting Service Bureau. The exhibition is certain to attract a host of visitors, and readers who wish to have full details of the arrangements should write to Mr. C. T. Allan, at Royal Chambers, Park Place, Cardiff, and ask for a programme. As joint hon. secretary of the Western Centre of the I.E.E., Mr. Allan is one of the moving spirits in the undertaking, which owes much to his enterprise and business ability.

JUNIOR INSTITUTION OF ENGINEERS.

The annual general meeting of this Institution was held at 39, Victoria Street, on November 14, and in presenting the council's annual report the chairman, Mr. C. O. Mourant, said that the Institution had maintained a very steady position in the past few trying years, and that there was a very good prospect now of going ahead in point of membership and usefulness.

At an extraordinary general meeting which followed a resolution was passed that the subscription for those under the age of twenty-two should be reduced to 30s. (or 25s. in the provinces), with an amendment that subscriptions for junior members should be payable quarterly. This will be submitted for confirmation at a second extraordinary general meeting to be held at a date to be announced later.

Various Items.

Engine for Sale.—An advertiser has for disposal a 200-h.p. Robey steam engine. For full particulars see small advertisement.

Tenders Accepted.—The municipality of Copenhagen have placed another large order for water tube boilers with the Vickers-Spearing Boiler Co., Barrow-in-Furness. This is the second contract the municipality has placed with this company recently.

Quotations Wanted.—The Victorian Railways, Melbourne, invite tenders for the supply of three-phase alternating current induction motors, starting apparatus and accessories. Specifications and conditions of tender can be seen by British firms interested at the D.O.T. (Room 52), 35, Old Queen Street, London, S.W.1

Meetings.—The Inst. of Production Engineers will meet at 7.30 p.m. to-night (Friday, Nov. 21) at the Engineers' Club, Coventry Street, W.1, when Mr. O. H. Medcalfe, of the Power Plant Co., Ltd., West Drayton, Middlesex, will read a paper on "Gear Cutting, with Special Reference to the 'Sykes' Generating System." (Slides.) The Council extend a cordial invitation to any who are interested in the above subject to attend the meeting as visitors.——The Junior Inst. of Engs. will meet on Friday, 21st inst., at 7.30 p.m. Lecturette, "Stainless Steel," by J. G. Hopcraft (Associate) Also on Friday, 28th inst., at 6.30 p.m., exhibition of latest scientific instruments and appliances for the use of engineers, and on Friday, December 5, at 7.30 p.m., lecturette, "Metal cutting Under Water by the Oxy-acetylene Blow-pipe," by J. B. Polland (slides and demonstrations). All at 39, Victoria St.

"**Fire-engine Construction.**"—On Friday, November 7, Mr. H. C. Jones delivered a lecturette on this subject at the Junior Inst. of Engineers, in the course of which he described the various items of equipment which a fire engine carries, and, in fact, dealt with the subject from all aspects, including the transformation from horse to mechanical traction. It was much appreciated by all present.

Irish Illuminated Cross.—The great cross at the top of the Roman Catholic Church at Clifden, Co. Galway, is to be illuminated by electricity. On clear rights it will be visible for many miles out in the Atlantic. The bulbs will be connected with a cable running down the inside of the spire—which is 200 feet high—and extra bulbs will be placed on the more exposed positions to overcome the difficulty of continuous replacement. The cross itself is 15 feet high and 6 feet wide. The work is being carried out by Mr. W. Larkins, a London steeplejack.

"**Pitman's Technical Bookshelf.**"—The October issue of this interesting house organ is now to hand. It contains information about many new technical books or new editions of standard technical works which have just recently been issued by this well-known publishing house, and it should, therefore, prove of direct interest to a very wide circle of readers, including teachers in science colleges, students and engineers generally. Application for copies should be sent to Messrs. Pitman, at 39 Parker Street, Kingsway, London, W.C.2, mentioning this notice.

Personal.—Mr. Godfrey Isaacs has been obliged, under doctor's orders, to resign his position as Managing Director and Deputy Chairman of Marconi's Wireless Telegraph Co., Ltd., and of the Marconi International Marine Communication Co., Ltd., which position he has held for 15 years. Both companies will continue to have the benefit of his assistance in a consultative capacity whenever required. The Rt. Hon. F. G. Kellaway, P.C., has been appointed Managing Director and Deputy Chairman of the respective companies. Mr. Kellaway has been a member of the boards of these companies for the past two years, and has taken an active part in their management.

Scott's Old Boys.—An interesting function took place at the Engineers' Club on Saturday, when men who served their time with Ronald A. Scott at Acton in the 'eighties collected from various parts of the country to dine. Mr. Newton Russell and foreman H. Sadd were the honoured and only guests. Amongst those present were W. E. Toy, W. M. Rogerson, C. E. W. Talbot, C. F. Jackson, A. B. Lillywhite, F. N. Haward, Ed. Davidson, H. Squire, W. Thomson, Robert J. Elmhirst, C. A. Smith, R. H. Orbell, F. Armfield, P. R. Smith, Reg. Cannon, Ed. Paterson and H. Marryat (Secretary). Old boys who have not heard from the Secretary should communicate their address to H. Marryat, 28, Hatton Garden, London.

Scholarships in Engineering.—The Council of the Beama have recently granted scholarships in Electrical Engineering, each of the value of £100, together with the payment of college fees, to the following gentlemen, viz.:— John Tempest Birtwell and George Emil Gregson Foden, both tenable at the College of Technology, Manchester; Percy James Maggs, tenable at the City and Guilds (Engg.) College, South Kensington; Harold Giles Richards, tenable at Birmingham University, and Raymond Robinson, tenable at Durham University. Also, Renewals of Scholarship for one year to Arthur Bernard Everest, tenable at Birmingham University; Isaac Herdman Hedley, tenable at Durham University; George Sail Campbell Lucas, tenable at the City and Guilds (Engg.) College, South Kensington, and Bruce Sydney Pelton, tenable at the University of London.

CASING AND CAPPING.
BLOCKS, CLEATS, BOARDS FOR SWITCHES
in stock and made to any design.
ACCUMULATOR CASES and BATTERY BOXES
Made to Order.
J. F. & G. HARRIS, Ltd.,
Timber Merchants and Moulding Manufacturers,
SAWING, PLANING, MOULDING & GENERAL WOODWORKING MILLS
58g, WILSON ST., FINSBURY, LONDON, E.C.
Telephone No: 1168 London Wall Please write for Illustrated Price List.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

NOVEMBER 28, 1924.

CONTENTS. PAGE

Testing and Treating Power Plant Feed Water 643
Protective Apparatus for Electrical Machinery 644
Electrical Engineering—Grade I. 645
Our Wireless Corner 646
Questions and Answers by Practical Men 646
Current Topics 649
Electric Passenger Lifts 651
An Elementary Investigation of the Energy of a Magnetic Field 655
Reviews of Books 656
Trade Notes 658
A Novel Method of Starting Polyphase Synchronous Motors 659
Various Items 660

TESTING AND TREATING POWER PLANT FEED WATER.*

By H. RAINFORD, D.F.H.

Careful analysis and judicious use of chemicals are necessary to ensure long life of boiler and condenser tubes. Power plant water will corrode, it will scale, it will prime. It has to be kept from doing all three things or so nearly kept from doing them as to make their evil effects of small consequence.

Boiler water will not corrode if it is alkaline, but not too alkaline. It will not scale if its sulphates are converted into carbonates. It will not prime if undue concentration of feed water is prevented in the boiler drums.

The impurities in feed water can be divided into two classes:—

(1) Insoluble impurities, which can be removed by filtration.

(2) Soluble impurities, which need to be thrown into suspension and then removed by filtration.

The most common of class (2) are calcium sulphate, calcium carbonate, magnesium sulphate, magnesium carbonate, and sodium sulphate. There is always some free carbonic acid which promotes corrosion.

The following table shows an analysis of a sample of town main water:—

Calcium carbonate ...	10.20	grains per gallon.
Calcium sulphate ...	1.42	,, ,,
Magnesium sulphate ...	0.63	,, ,,
Magnesium chloride ...	0.71	,, ,,
Sodium chloride ...	1.44	,, ,,
Free carbonic acid ...	0.70	,, ,,
Hardness	12.5	,, ,,

As a basis of judgment for the treatment needed, it is necessary to have a knowledge of the hardness, causticity, and alkalinity of the feed water.

Hardness is the most widely known evidence of the presence in water of scale-forming matter. It is classed as either temporary or permanent. Temporary hardness is due to carbonates of lime and magnesium which may be precipitated by boiling at 212 deg. F. Permanent hardness is mainly due to calcium sulphate.

Alkalinity is the general term used for water containing compounds with the power of neutralising acids.

Causticity, as used in water treatment, is a term indicating the presence of an excess of lime added during treatment. Though such presence would also indicate alkalinity, the term is arbitrarily used to apply to those hydrates whose presence is indicated by phenolphthalein. Hence the term "phenolphthalein alkalinity" is often used instead of causticity.

In the treatment of feed water the essential chemical required is a soluble carbonate, or a soluble hydrate, or both. A cheap soluble carbonate is sodium carbonate (*i.e.*, soda ash). A cheap hydrate is lime, and the "lime and soda" process is by far the most generally used in water purification. Sufficient soda is used to break down the sulphates of calcium and magnesium, and as much lime is added as is required to absorb the carbonic acid not taken up in the soda reaction. To prevent corrosion sodium hydrate (*i.e.*, caustic soda) is often used to supplement the sodium carbonate, it being presumed that it absorbs the carbonic acid, becomes carbonate of soda, and acts as above. When properly treated, alkalinity, hardness and causticity should be in the approximate relation of 6, 5 and 4. When too much lime is used in the treatment, the causticity of the treated feed water will be nearly equal to the alkalinity. If too little lime is used the causticity will fall approximately to half the alkalinity. The hardness should not be in excess of two points less than the alkalinity.

Concentration of Feed Water in Boilers.—Priming is caused by the concentration of sodium carbonate, sodium sulphate or sodium chloride in solution.

Practically all power plant water contains sodium chloride (common salt), which does not undergo any changes in the actions and reactions which make other substances in the water the source of so much trouble. Therefore, if the amount of sodium chloride in the concentrated water of the boilers and in the feed water are determined, the one figure against the other will give the ratio of concentration of the boiler water compared with the feed water.

In conclusion, it is safe to say that the question of power plant feed water is a local one, *i.e.*, the water supply available for different plants varies in its chemical properties, and each plant calls for different treatment and sound judgment concerning the reacting agents employed. The required proportion will vary according to the feed water used, and once this has been determined it is only necessary to maintain the conditions to secure excellent results. It is obvious, however, that feed water treatment must be undertaken with care, and frequent analysis should be made of samples taken from the make-up water, the boiler feed, and from the boiler drums to ascertain that the correct conditions are being secured.

Nobody cares if his sin finds him out, but he doesn't want it to find him in.

---

* From the *Faraday House Journal*.

PROTECTIVE APPARATUS FOR ELECTRICAL MACHINERY.

An instructive paper was read recently by C. J. Monk and N. D. Penney before the South African Institute of Electrical Engineers, and some of the more salient points are here reproduced. In these days of growing networks—increasing alike in power, extent and complexity—it is needless to emphasise the importance of automatic protective gear, and though no new principles or radical changes may be dealt with below, it is believed that many readers will appreciate the presentation of the leading problems in a simple manner.

The dimensions of electrical machinery are approaching those values which we at present believe to be the workable limits of temperature and stress of the materials at the moment available, and the small percentage of capital used for the protection of generators is undoubtedly a good insurance against the possible premature depreciation of the plant. The fundamental principle underlying protective apparatus for use with modern alternators is to limit the damage and so obviate expensive repairs.

The influence of protection may extend far beyond the individual unit protected. For example, in the case of two power stations, one of which is able to produce power more cheaply than the other, any transference of load, due to the failure of plant, from the more favourably situated station to the other, would result in an increase in the cost of production. As this increase is irrecoverable, it could rightly be charged up as part of the expenses incurred in effecting the repairs to the faulty portion of the plant. In the case of the breakdown of a modern turbo-alternator of 20,000 kw. capacity for a period of several weeks under these circumstances, this extra cost could conceivably be in excess of the actual cost of rewinding the complete stator.

SOME IMPROVEMENTS IN PROTECTION.

In introducing the Merz-Price differential protection, the originators of selective protection were instrumental in devising a system whereby any faulty portion of the equipment comprising an electrical supply undertaking would automatically be taken out of service without necessary interruptions to any other sections of the plant.

Whilst the great increase in the amounts of power handled by both suppliers and users of electrical energy has resulted in, and still accounts for, the redesigning of plant to withstand the increased forces to be met with, the secondary circuits inductively supplied for measuring the amount of power and operating the various automatic devices used for protection still operate at approximately the same value, with the result that the accuracy of these secondary circuits has of necessity been improved in order to keep pace with the growth in value of the primary currents.

In the case of protective circuits the result has been to modify somewhat the original application of differential protection. The dangers from "straight through" currents for feeder protection and capacity currents in the pilot wires have resulted in the use of biased relays and drainage coils, or the duplication of the main circuits as instanced by the split conductor system.

In transformer and generator protection, the more improved design of current transformers has resulted in complete sets of these being manufactured with similar characteristics, but at the same time of widely different ratios.

REASON FOR FURTHER IMPROVEMENTS.

The effect of adopting a standard normal full load secondary current for the differential protection of generators and transformers is to decrease the relative sensibility of the protection as the size of the plant increases. This becomes obvious when it is remembered that an increase in the rating of the plant is accompanied by an increase in the ratio of current transformers used for protecting that plant. For example, a 5,000 kva. machine with a 500/5 amp. current transformer may need a 50 amp. fault (or 500 kva.), whereas a 20,000 kva. machine with a 2,000/5 amp. transformer may need 200 amps (or 2,000 kva.) before the protective relay could operate.

DIRECTIONS IN WHICH IT IS POSSIBLE TO EFFECT IMPROVEMENTS.

The normal sequence of events when a fault develops in a generator is somewhat as follows:—

(1) The fault develops sufficiently to operate relays.

(2) The oil switch disconnects the machine from the main bus-bars.

(3) The fault current continues to flow until the field breaking switch operates.

Therefore, in order to limit the damage that is generally done to a machine when a fault develops, it will be necessary to effect improvements in at least three directions:—

(1) To decrease the time lag between the initial development of the fault and the disconnection of the generator from the main bus-bars. It is obvious that the quick tripping of the switch is necessary, as it serves a double purpose; it prevents the feeding back from other generators, or even a whole system of power stations, into the fault, and it also facilitates the quick "killing" of the generator.

(2) The extent to which the fault is allowed to develop is only a controllable factor in certain classes of failure. Fault currents either flow in parts of those circuits in constant use, such as any of the three circuits in a three-phase generator, or else traverse a special circuit, the resistance of which can be selected to produce any desired results, *i.e.*, the earth-return circuit in which is usually inserted a special resistance. Methods for effecting improvements in this direction will be dealt with later.

(3) Improvements are sought in reducing the flux in the rotor in the shortest possible time to a value at which it could not be responsible for extending the damage already done. The possible failure of this section of the protective equipment should on no account be overlooked; its failure to operate might result in severe damage, and any rearrangement of the existing protective apparatus, which would result in reducing the risk from such failure, should be carried out.

In examining the results of electrical breakdowns in the stators of alternators, it will be seen that the actual amount of damage could be represented by an expression giving the magnitude of the current passed through the faulty portion of the windings and the time during which the current flowed, so that for the purpose of analysis, with a view to limiting damage caused by breakdowns, the results could be expressed thus:—

$$D = CN$$

where D = Total damage to conductors and/or core of generator at the point of breakdown.

C = Current component, *i.e.*, the mean value of the current at the point of breakdown.

N = Time component, *i.e.*, the number of seconds or cycles during which the fault persists.

If, therefore, either C or N could be reduced to zero, then the total damage would be zero; this means that the prevention or limitation of damage can only be brought about by reducing in value either or both of C or N. For the purpose of avoiding any confusion on the question of faults in generators, the generators themselves may be divided into two distinct groups:—

Group (A) consists of generators which have a terminal pressure equal to the voltage of the main bus-bars.

Group (B) consists of all generators which have a lower terminal pressure than the main bus-bar pressure, and are directly connected to a step-up transformer.

(To be continued.)

ELECTRICAL ENGINEERING—GRADE I.*

Solutions to 1924 Examination Questions of the City and Guilds Institute.

BY EDWARD HUGHES, B.Sc. (Eng.), A.M.I.E.E.

(*Continued from page* 639.)

Q. 12.—Explain why a shunt motor, with constant excitation and applied voltage, runs at nearly constant speed under all loads. How can the starting torque of such a motor be increased with a given armature current?

A. 12.—In the case of a shunt motor with constant excitation, the magnetic flux remains nearly constant between no load and full load so long as the armature ampere-turns are weak compared with the field ampere-turns, the effect of armature reaction being then very small.

Now the e.m.f. generated in the armature is directly proportional to the magnetic flux and to the speed,

i.e., $E = k\Phi R$

where Φ = useful flux per pole,

R = speed in r.p.m.

and k = a constant for a given machine.

In a motor, this generated e.m.f. E is a counter e.m.f., *i.e.*, it acts in opposition to the applied voltage V; and it is the difference between V and E that is responsible for sending current through the resistance of the armature circuit,

i.e., $V - E = Ir$

where I = current through armature,

and r = resistance of armature.

Substituting for E, we have—

$$V - k\Phi R = Ir$$

$$\therefore R = \frac{V - Ir}{k\Phi}$$

But the value of Ir at full load is only about 3 to 6 per cent. of V, so that—

$$R = \frac{V}{k\Phi} \text{ approximately.}$$

In other words, the speed of a shunt motor with constant excitation and supply voltage is nearly constant between no load and full load.

The torque exerted by an electric motor is proportional to the product of the armature current and the magnetic flux per pole. Consequently, for a given current, the torque can be increased only by increasing the magnetic flux per pole; and for a given shunt motor, this can be done only by increasing the exciting current by means of a shunt regulating resistance, the maximum excitation being obtained when there is no external resistance in circuit.

(To be continued.)

RESEARCH IN THE CABLE INDUSTRY.

At the informal meeting of the I.E.E., on Monday, 10th inst., Mr. A. H. Allen was in the chair, when Mr. P. Dunsheath, M.A., O.B.E., opened a discussion on this interesting subject. Mr. Dunsheath, who directs Messrs. Henley's Telegraph Works Research Department, showed a number of lantern slides illustrating the plan and elevation of the research laboratories, the testing-rooms and experimental workshops, the rooms where high-power microscopes reveal the organic structure of dielectrics, etc., as well as the half-way factory where the conclusions of the laboratories are tried out on a large scale before being passed on to the factory stage.

He said that although applied science had been recognised as the basis of industry, it required the severe jolt of the war to secure a more general adoption of scientific methods. We still lag far behind the United States and Germany in our investigations, but as a direct outcome of the war the British electrical industry in particular had most completely taken up scientific research.

The electrical industry had been the pioneer in systematic investigations, and many of the conclusions of the Committee of Research on Submarine Cables in the middle of the last century may still stand as a model and as a text-book.

Mr. G. L. Addenbrooke endorsed Mr. Dunsheath's appreciation of the conclusions of the Research Committee of 1860. He pointed out that text-books hitherto have but briefly noticed dielectrics, yet in studying dielectrics we are investigating matter itself. In the light of the electrical theory of matter we must feel that we can't have matter in an electric field without altering it in some way, and workers in research on dielectrics are most likely to come across phenomena that may have results that we can to-day hardly appreciate.

Mr. T. N. Riley mentioned that the staff of the research departments of the Western Electric Company in U.S.A. numbered 3,000, and that this mass investigation had produced some very valuable developments. He instanced the Azores Cable.

---

* Books recommended are *Elements of Electrotechnics*, by Young (7s. 10d. post free), and *Technical Electricity*, by Davidge and Hutchinson (13s post free), both from S. Rentell and Co., Ltd., 36, Maiden Lane, London, W.C 2.

Mr. A. Rosen thought Mr. Dunsheath had been too broad in his classification of problems as mainly concerned with conductor and dielectric. There are problems arising from the hundred different applications of cables. Cables of minuted load up to those of large capacity, cables used on zero periods up to those for one hundred periods for power, cables for 300 periods for telephones, frequencies up to millions even for radio work.

Mr. E. S. Ritter described some of the very difficult requirements of long-distance telephone cables and the room for improvements in this department. A promising field for research is in cables for continuous working.

Mr. A. H. Allen spoke of the need for research into the literature of the early investigators, a great deal of which was now hardly known, yet their conclusions were of the utmost value. He pointed out the importance of cables; this may be realised from the fact that approximately half the capital of the electrical industry is sunk in cables. Speakers had asked for information on the production of high-tension cables; he asked Mr. Dunsheath if he could give us some authentic news of, say, a 30,000-volt cable.

Messrs. J. H. C. Brooking, A. Collins, J. Coxon, W. Day, R. D. Gifford, D.Sc., A. G. Hilling, W. E. Newberry, P. Rosling, H. Savage and H. C. Silver also spoke.

Mr. Dunsheath, in reply, agreed with the view that research work in allied trades was not all it should be. He came across many rule-of-thumb methods, notably in the paper-making trade. In the United States cable research was actually carried out by the users as well as by the manufacturers. In regard to E.H.T. cables he had that day seen tested a three-core 66,000-volt cable. This was not an experimental cable, but a length manufactured to an order.

Our Wireless Corner.

SMALLEST RADIO DEVICES IN THE WORLD.

One of the many unusually interesting features at the Third Annual Chicago Radio Show, which opened on Tuesday, November 18, and continued until midnight, Sunday, November 23, was a collection of the smallest workable radio devices in the world.

Some of the tiny receiving sets are built on the lines of the old open style apparatus, while others are mounted on diminutive panels which are in turn fastened upon little cabinets. None weigh over an ounce, but radio broadcasting can actually be received on all of them. In fact, workability is one of the requirements for admission to the "Miniature Model Exhibit." One receiver, for instance, about the size of a small marble, has a perfect little tuning coil, a crystal detector and two switches which touch minute contact points on a Lilliputian panel. This set was built by Mrs. Edith Bornemann, of Bethany, Nebraska. Another, even smaller, built by T. L. Cranston, of Toronto, Canada, has a flat wound coil and is encased in ivory.

There is a perfect telephone receiver built by E. Dickey, of Dayton, Ohio, among the models that is considerably smaller than a shoe-button. There is also a wonderful miniature loud-speaker weighing only a few pennyweights, made of solid gold, the work of Ivan T. Nedland, of Hillsboro, N.D., that actually speaks. Its magnets are wound with wire so fine that if a single strand were stretched out on a table it would hardly be visible to the naked eye.

A battery cell not half an inch high, made by Patsy Cordi, of Derry, Pa., actually gives current that can be measured by suitable instruments.

There are also crystal set entries in this unique department by Henry Dahl, of Minneapolis, Minn., Dr. Hugo S. Thompson, of Springfield, Mass., C. D. Pace, of Detroit, Michigan, A. Hauser, of San Francisco, Cal., and Helen Giles, of East Orange, N.J. John W. Fuller, jnr., of Jersey City, N.J., is exhibiting a miniature telephone receiver, while Hermann Burgess, of Washington, D.C., is showing a receiving set mounted on a finger-ring. D. L. Roberts, of Corydon, Iowa, has entered a vario-coupler, said to be the smallest device of its kind ever built, and J. H. Muldoon, of Birchdale, Minn., entered a perfect honeycomb tuner, which scaled only five pennyweights.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 191.

How can I convert my crystal receiving set into a one-valve set with a minimum expense?—"ASTATIC."

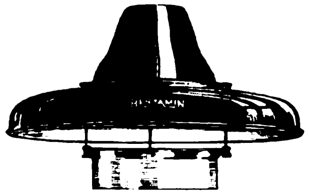
QUESTION NO. 192.

In the plant at our colliery, our motor load is running at .6 power factor. How can I improve this? Would it be better to improve this to unity power factor or to some value below unity?—"A. F. JAMES."

(*Replies to Questions Nos.* 191 *and* 192 *must be received not later than November* 29, 1924.)

We have received from **Welsbach Light Co., Ltd.**, of 344-354. Gray's Inn Road, London, W.C.1, a copy of their new list No. 464. This is quite a comprehensive catalogue of electrical appliances and accessories ranging from the well-known Rowenta electric cooking appliances, irons, boiling plates, toasters, and similar goods, for which they have built up such a splendid reputation, down through a large assortment of pendants, descriptive electroliers, standards and ceiling plates, to lamp holders, switches, wall plugs, batteries and cables. In fact, it covers the supplies essential to every installation contractor as well as to the retailer who makes a speciality of pushing electrical goods among his private customers, and we can, therefore, recommend it to all trade readers as a book which should be written for without delay.

Brilliant Light Without Glare
The BENJAMIN BIFLECTOR



The latest contribution to scientific illumination.

Ideal for Spinning Frames, Weaving Looms, Compositors' Frames, Offices, Schoolrooms, Hospitals, etc., etc.

Advt. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application.

Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited, and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL & CO., LTD., 36-39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

Ancient and Modern.

The ancient city of York now enjoys equal telephone facilities with that other fortunate Yorkshire city, Leeds, a Strowger Automatic Telephone Exchange having just been put into commission by the Post Office to serve some 1,700 subscribers. This conversion from the obsolescent manual system previously in vogue there marks the latest of a series of projected conversions to the more modern service throughout the country, including the very considerable programme of providing Strowger automatic telephones for Greater London, work in connection with which is already well in hand. More than ten years ago the Post Office commenced experimenting with automatic telephony on a limited scale, the first Strowger automatic telephone exchange in this country being opened at Epsom. There are now 24 British exchanges converted to the automatic principle and serving in all some 47,000 subscribers. Thanks to a broader outlook, the Department is now proceeding with a very promising programme of modernisation, and we hope to be able to report still other changes to automatic working in the provinces very shortly.

Meanwhile, York residents are delighted with the new system, which saves the irritating delays and errors inseparable from a telephone service conducted through the old-fashioned manual switchboards. The handy calling dial affixed to the instrument is quite easy to master, and with a little practice the average user can make and clear half a dozen calls in less time than was required for one connection under the old system. In regard to the conversion of the London service to Strowger automatic working, we now learn that to deal with the 300,000 telephone subscribers within ten miles of Charing Cross no fewer than 71 automatic exchanges will be needed. Considerable preparatory work is necessary before the first London exchange is opened up for automatic service, and although every effort is being made to expedite this, it is unlikely that the new Sloane exchange, the first of the series, will be ready for use before 1926.

Powerful Allies.

One of the best moves towards increasing the domestic load and augmenting the efforts of the E.D.A. is the formation of the new Women's Electrical Association. The organisation was launched at a meeting held on November 12 at the house of the Hon. Lady Parsons in the presence of a large gathering fully representative of men and women electricians, women's housing councils, the various women's organisations, health and welfare workers, and of working-class women. Credit for the conception of the idea rests with Mrs. Matthews, director of the electrical department of a large firm. It has been decided that the association shall consist, roughly, of three sections, comprising housewives of all classes of society, representatives of public services, and women engineers. Demonstrations of existing electrical apparatus and simple lectures will be given in connection with social afternoons, and it is proposed to form a juvenile section.

As a lady present at the inaugural meeting pointed out, the ignorance of the average housewife about simple electrical matters is simply appalling. A woman had once informed her that she did not use a vacuum cleaner for fear of burning her carpets. Women ought to understand how to use and replace fuses and should be able to do simple electrical repair jobs in their own homes. It is doubtless a fact that ignorance of the simplest electrical details, coupled with a fear of danger from shock, fire, etc., has militated considerably against the more widesperad use of electrical appliances in the average household, even where the necessary supply has been available. Mr. J. W. Beauchamp, of the Electrical Development Association, was present at the inauguration and promised the new organisation support and encouragement of a practical character.

A Well-Merited Honour.

In its new Mayor, Alderman H. Leese, J.P., the County Borough of Stoke-on-Trent has chosen a very able leader of its local government. Alderman Leese fought his first municipal election thirty-five years ago, and made his entry into local government twenty-one years back, when he became the representative of the present No. 21 Ward of the old Stoke Council. He has particularly distinguished himself in matters appertaining to the supply of electricity. In 1904 he was appointed to the Electricity Committee of the Stoke Council, and was connected with the starting of the electricity works in that town. In the same year that federation took place he became chairman of the Electricity Supply Committee of the body administering local government in the Federated Potteries area. He has thus played a very important part in the development and progress of this branch of the public service for fourteen years.

At the time Alderman Leese was made chairman there were separate small generating stations in each town, but since his appointment a centralisation scheme has been embarked upon, with many big extensions in consequence. The Stoke-on-Trent Corporation is now regarded as possessing one of the finest municipal electricity undertakings in the country. Two years ago Alderman Leese was elected on the National Council of the Incorporated Municipal Electrical Association. He has also acted as chairman of the North-West Midlands District Electricity Committee, set up in connection with the establishment of a chain of big power stations. This committee has since been subdivided into two sections, and Alderman Leese remains chairman of the northern section, which comprises Stoke-on-Trent, Newcastle, Leek, Stafford, and Market Drayton. From the electrical standpoint, at all events, Stoke-on-Trent is to be congratulated upon its present selection for the mayoral chair.

As Others See Us.

It is often extremely helpful to have the criticisms of those outside our own industry as a spur to greater effort and a corrective in case of error. It is a very true adage that the looker-on sees most of the game, and those more intimately engaged in an industry are apt to acquire a very narrow outlook on things in general, and more particularly on matters directly affecting their own prosperity. Thus one welcomes the critical comments of a writer in our contemporary, *Engineering*, directing attention to the desirability of cheapening the cost of distribution of electrical energy by a greater use of "overhead networks in this country." If, as has been claimed, the cost of distribution of electricity for lighting adds 300 per cent. to the cost of production, it would appear worth some considerable effort to cut down the cost of distribution. One method of accomplishing this would appear to be a much more extended use of overhead networks, not only for main, but also for secondary distribution. As our critic points out, there is no need to go to the Continent to see quite satisfactory overhead networks supplying small towns. There are plenty of examples in Great Britain. There does not, however, appear to be any serious effort on the part of supply authorities to extend the system to any considerable degree. It is sometimes said to be unsightly, but we are unable to see that it is as objectionable in this respect as some of the overhead erections of the Post Office, which are taken as a matter of course.

Apart from this question of overhead distribution, our friendly critic also has a tilt at the apathy of many supply authorities in cases where cables are already laid along existing streets and not made full use of. Once a main is laid down a street, he says, it would appear reasonable to take considerable trouble, and even to spend some money, to get as many houses connected to it as possible, but one in general does not find supply authorities dealing with matters of this kind with an energy corresponding to that of the gas companies. Further, although electric light suppliers are not likely to make much profit from doing business at a loss, one sometimes wonders if they do not play too safe, and if more attractive terms might not very quickly lead to considerably extended business and greater total profits.

Benevolence.

Yet another successful annual festival of the Electrical Trades Benevolent Institution must be placed to the credit of those responsible for the management of this very deserving charitable fund. Mr. Dane Sinclair was chairman at the dinner which was held at the Trocadero on Wednesday, the 9th inst., and after he had read a letter from Sir David Salomons, Bart., the president of the Institution, regretting his inability to attend, he (Mr. Sinclair) referred briefly to the natural instinct of mankind to help one another, and then went on to make a powerful appeal to all present as well as to the industry at large to aid the Institution to the utmost of their power. It was a terse and rugged speech, which went to the hearts of all of us.

He was followed by Mr. W. B. Woodhouse, president, I.E.E., who proposed "The Ladies," and said with truth that the great cause of charity has no stronger supporters than the members of their sex from their knowledge of the needs of the widow and orphans when death had overtaken the breadwinner of the family. For that very reason he thought the fund ought to get more assistance from them and he hoped it would do so. With the toast he coupled the name of Miss Clara Hazlitt, the secretary of the Society of Woman Engineers, and I need hardly say it was received with much enthusiasm.

Miss C. Hazlitt.

I must say that Miss Hazlitt made a most charming response. She thought the institution ought to receive all possible support from the ladies, for the simple reason that it represented the real human element, and as such made a direct appeal to them. She then went on to refer in a most complimentary manner to the Institution of Electrical Engineers and the fact that it was the first institution to admit women as members, and alluded to the formation a week previously of the Women's Electrical Association, which would, she hoped, do much to promote electrical progress in the home.

£50,000 Wanted!

Then Mr. J. Y. Fletcher rose and proposed Mr. Sinclair's health, coupled with thanks for the way in which he had presided over us, after which he went on in a way which would make Oliver Twist blush. He wanted "more," "much more," and the fact that the funds were approaching the £30,000 mark merely made him say that he thought there was luck in odd numbers, and he was now aiming at £50,000. As he is chairman of the finance committee and one of the most energetic workers in a good cause, I expect he will get it. At any rate I hope so, and we must all do our best to help it along. Mr. Sinclair acknowledged the toast with a few suitable words, and then told us that the subscriptions for the year now amounted to £1,598 11s., including a sum of one hundred guineas given by Mr. H. Alabaster, of the *Electrical Review*, who may be claimed as an old friend by a very large proportion of the electrical industry. Finally, I hope my readers will give serious consideration to the value of joining the Institution. The advantages to the trade rank and file are great, and the annual contribution is so small that I cannot understand any common-sense individual stopping out of it. Full details may be obtained from the Hon. Sec., Mr. F. B. O. Hawes, at 98, Grosvenor Road, S.W.1, and the more that join it the better he will be pleased.

ELEKTRON.

Who abuses his health destroys his wealth.

ELECTRIC PASSENGER LIFTS.*

BY H. MARRYAT (Member).

(*Continued from page* 628.)

With car-switch control the connections are simpler, inasmuch as the push-button circuit and relays are omitted, the connections from the car switch being made direct to the solenoid direction switch. The diagram of connections of the control panel with which I am more particularly acquainted is given in Fig. 10. The same panel is used in connection with either the push-button or car-switch method of control. With this controller the shunt field of the motor is always left connected across the armature when the main current is disconnected. This arrangement entirely eliminates failure due to inductive discharge on opening the field circuit, and another valuable feature is that the controller is of the double-pole type, the main source of supply being switched on and off at both poles at each operation of the lift. This eliminates a most insidious form of fault inherent in almost every other form of controller, in which an earth developing on one or other part of the control system may, under certain circumstances, allow of uncontrolled movement of the car.

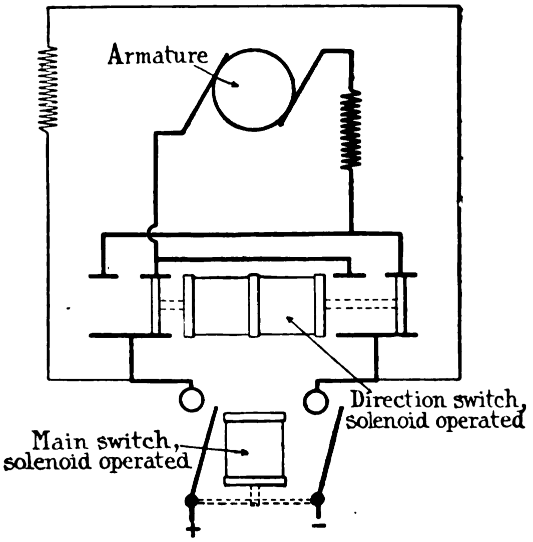

Armature
Direction switch, solenoid operated
Main switch, solenoid operated
+
-

FIG. 10.

A very useful form of control, and one not sufficiently employed, consists of a combination of the push-button and car-switch with a change-over device, so that during busy periods the lift may be car-switch operated at high speed by an attendant, and during slack periods push-button operated at a lower speed by the passengers.

The essentials of a good lift controller are that it shall start and accelerate the lift in the minimum of time consistent with the comfort of passengers, and decelerate and stop in like manner, at the will of the operator. It must be reliable for a service sometimes extending to thousands of operations per day, and must be thoroughly robust and so constructed that a replacement or adjustment can be made readily without the possibility of upsetting the accuracy of its action. For many positions it is also often desirable that the controller should be silent in its operation.

As illustrating the service which these controllers are sometimes called upon to perform, a count was recently made in a drapery establishment in Oxford Street, London, in which two lifts each performed an average of 2,000 journeys per day. In making these tests great care was taken to eliminate any possibility of error. The motor rooms were kept locked, and accurate instruments were employed for counting and registering the work done. Independent observers were employed to check the results. During the whole month the only stoppage that occurred was one of ten minutes upon one of the lifts to replace a car-switch contact.

It may be claimed, then, that electric lift controller designs have attained a high state of reliability. The most promising line for further advancement would seem to be in the direction of deceleration control, especially in conjunction with automatic lifts, thus permitting higher running speeds to be employed.

The energy consumption of an electric lift is principally dependent upon the number of times the lift is set into motion. The current required to accelerate the moving parts is far greater than that necessary to maintain the lift running, and very little, if any, of this current is returned to the line during deceleration.

It follows, then, that with a car-switch lift the energy consumption depends very largely upon the skill of the operator in stopping the lift at floor level. If he finds it necessary to "inch" at each stop, the energy consumption is enormously increased. This must always be the case when a new or an unskilful operator is employed. The higher the running speed of the lift the more likely is this loss to occur, owing to the increased difficulty of gauging floor level.

Each lift maker has developed one or more devices to overcome this difficulty, but the fact that various makers recommend various solutions is in itself indicative that finality is not reached. Two-speed or three-speed control is sometimes made use of, the connections being brought back to the car switch, upon which two or three stops in each direction are provided. Messrs. Waygood-Otis have introduced a device termed the "Micro-drive," which not only attains the end in view, but also maintains the car at the exact floor level irrespective of the stretching of ropes or any other circumstance. That is to say, the lift having stopped at a particular floor, a heavy load wheeled into it may cause the car to sink—say, half an inch—then the micro-drive machine will at once get into action and raise the car that half-inch. Mr. C. H. I. Day, in describing the micro-drive lift before the Association of Engineers-in-Charge, stated that it embodies two essential parts, the main hoisting machine and the micro-attachment.

The main hoisting machine, with the exception of the magnetic brake, involves no special features. The main brake is usually of the regular shoe type, except that the housing or frame, instead of being bolted to the bedplate, is fastened to the worm-wheel shaft of the micro-gear and revolves with it. This main brake performs a double function; first, with the micro-gear at rest it acts as a brake to stop the main machine; and, secondly, when the micro-gear operates, it acts as a friction clutch driving the main machine. The micro-gear is in itself a small machine consisting of a motor, brake and worm-gear reduction.

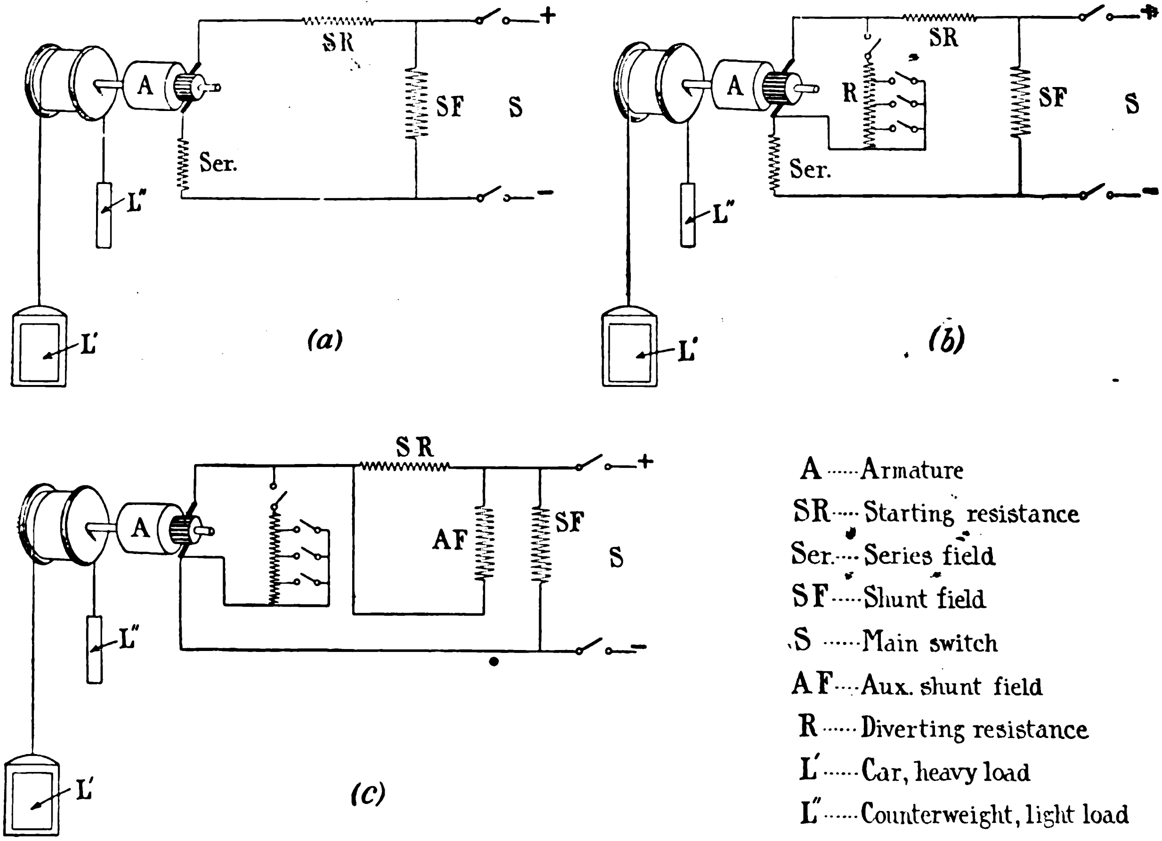
---

* Paper read before the Institution of Electrical Engineers.

With the micro-levelling machine two controllers are combined in one, one to control the operation of the main motor and the other to control the operation of the micro-motor. The main controller is operated in the usual manner, i.e., by push-button, car-switch or mechanical control. The micro-controller is operated by a levelling switch mounted on the car frame. This levelling switch consists of two sets of contacts which control the micro-motor, one for the up and the other for the down direction. These contacts are operated by stationary cams in the lift shaft, there being two cams at each landing, one of which operates the up contacts and the other the down contacts. As the car approaches the floor at which it is intended to stop, the circuit of the main motor is interrupted, either automatically in the case of push-button control or by the car-switch or mechanically operated mechanism.

If the main machine brings the car or platform above or below the desired floor level the levelling switch engages with the cams in the lift shaft, thus operating the micro-motor. The micro-gear will then automatically lower or raise the lift until it is absolutely level with the floor, when the levelling switch will interrupt the circuit of the micro-motor and stop the car, due to the lever having disengaged itself from the fixed cams on the wall. This position of the car will now be maintained under all conditions of loading, as the automatic control of the micro-motor is independent of the door or gate contacts, i.e., if the position of the car relative to the floor should be slightly changed, perhaps by increasing or decreasing the load, the lever operating the levelling switch will once more come into contact with the cam, and the micro-gear will be started up and immediately return to its proper level.

Of course, it is necessary to provide some means of preventing the micro-gear from operating when passing floors at which it is not desired to stop. This is accomplished by means of a magnet mounted on the levelling switch. When the car is being operated from the main motor, this magnet is energised, and prevents the levelling switch from engaging with the cams in the lift shaft. When the power is cut off from the main motor this magnet is de-energised, and if the car is in the micro-zone, i.e., near to but not level with the floor, the levelling switch engages with the cams.



A ...... Armature
SR ...... Starting resistance
Ser. ...... Series field
SF ...... Shunt field
S ...... Main switch
AF ...... Aux. shunt field
R ...... Diverting resistance
L′ ...... Car, heavy load
L″ ...... Counterweight, light load

FIG. 11.

There are, no doubt, many special applications for such an arrangement, but for the purpose we have in mind at the moment it is questionable if the expense, as compared with that of other methods, is justified. There would also seem to be some danger, if the micro-drive can move the car whilst the gates are open, of a passenger being caught by the toe or in some other way between the slowly moving car and a fixed part of the well—a class of accident which has frequently occurred with hydraulic lifts.

A device to attain the same end—evolved and patented by Mr. Murray D. Scott, is inexpensive, and has the advantage that the motor and controller employed are normal in every way, and that a certain amount of the energy utilised may be returned to the line. The Scott automatic decelerator may be described by reference to Fig. 11 (*a*), (*b*) and (*c*), the first shows the normal arrangement of a D.C.

motor (compound wound) to the armature, of which a winding drum is attached, and having two unequal weights suspended by cables therefrom. If we imagine the armature rotating in a clockwise direction and the machine being started up in the usual way, it will readily be appreciated that, on the current being switched off, the armature will be brought to rest rapidly, the load L′ being considerably heavier than the load L″. If we now imagine the armature rotating in an anti-clockwise direction, on switching off the current the load L′ will continue to exert a rotating torque on the armature shaft, thus prolonging the period of deceleration.

Fig. 11 (*b*) is a similar arrangement, except that a resistance R is arranged in parallel with the armature, a switch being inserted to throw this resistance in or out of circuit.

Let us now consider the case of the armature revolving in a clockwise direction. If before opening the main switch we close the diverting resistance circuit, the voltage across the armature terminals will be reduced, thus causing the motor to decelerate to any predetermined minimum governed by the additional short-circuiting switches on the resistance R. The motor may be finally brought to rest by opening the main switch S.

If the motor be running in an anti-clockwise direction, the preponderance of the weight L′ may cause the motor to generate current. Closing the diverter resistance circuit will put a load on the armature, and additional short-circuiting switches will cause the machine gradually to decelerate as before until the main switch S is finally opened for stopping the machine.

It is found that by correctly calculating the diverting and starting resistances the motor deceleration may be accurately predetermined and will be practically independent of varying loads. An improvement is shown in Fig. 11 (*c*) which illustrates the motor wound with an auxiliary shunt field connected in parallel with the starting resistance. This has all the starting advantages of a heavily compounded machine without the consequent disadvantage of speed variation, the auxiliary field being automatically cut out as the starting resistance is short-circuited, and being again automatically strengthened as the armature voltage is reduced by the decelerator resistance.

A further development of this idea with special relation to automatic lifts permits of comparatively high running speeds being employed with the surety of accurate floor levelling under all conditions of load. The design, which is termed the "Auto-Pilot," has only recently been protected, and is in the experimental stage. Two knobs or large buttons in the car are marked distinctly "up" and "down." On one of these being depressed the lift accelerates and runs at normal speed. As the car passes each floor a signal light glows, and if the knob or push be released during the period of illumination the car will decelerate and stop level with the next floor.

(*To be continued.*)

Lloyd's Register Scholarships.—Seagoing engineers who have to take up the study of electrical engineering will be interested in the circular which has just been issued by the Institute of Marine Engineers, 85, The Minories, Tower Hill, London, E.1, giving details of the examinations for the above scholarships, dates when held, fees, awards, etc. The circular will willingly be sent on application.

AN ELEMENTARY INVESTIGATION OF THE ENERGY OF A MAGNETIC FIELD.

By S. A. Swann, B.Sc. (Eng.).

That a magnetic field possesses energy is evidenced by the production of a spark and consequent manifestation of thermal, luminous, and acoustical energy when such a field collapses, the energy being dissipated mainly at the point where the magnetising circuit is broken. It is a matter of common observation that the intensity of the spark increases with the current, and with the number of turns on the magnetising circuit. It will be shown subsequently that the energy of a magnetic field is proportional to the square of the magnetising current and to the self-induction of the circuit.

In a similar way, an electrostatic field possesses energy, which disappears when the field is destroyed, as when a condenser is discharged. In this case also the energy appears in the form of a spark, though it is known that under certain conditions the energy is rapidly oscillating between the electrostatic and magnetic forms during the discharge. The energy of an electrostatic field is proportional to the square of the applied voltage and to the capacity of the field.

It is to be noted that when a magnetic field is set up in a magnetic material which exhibits residual magnetism the whole of the energy does not disappear when the magnetising current is switched off, a certain proportion remaining in the material and its immediate surroundings. The presence of residual energy is proved by the fact that a magnetic body may be attracted, and hence work is done on it by the field, thus reducing the energy of the field. To restore the body to its original position work must be done on the field such as to restore its energy to the initial value. The principle of the convervation of energy holds equally for magnetic, electrostatic, and mechanical and other forms of energy, and may be applied to solve various electrical problems. As an example, it may be recalled that the question of determining the resonance frequency of a circuit possessing inductance and capacity is solved by utilising the fact that the sum of the energies of the electric and magnetic fields is constant.

It is important to note that the energy of a magnetic field is imparted to it during a very brief interval of time following the instant of switching on, and must not be confounded with the continual absorption of energy by the magnetising circuit due to its resistance. Similarly the energy is given up when switching off; it is not returned to the circuit, however, but becomes inaccessible by dissipation and for all practical purposes is lost.

The magnitude of the energy associated with a magnetic field may be obtained quite simply as follows.

Let N be the number of turns on the magnetising coil and i, ϕ, be corresponding values of current and flux at the instant t secs. from the instant the field commenced to build up.

Then the self-induced back EMF

$$= N \frac{d\phi}{dt} \times 10^{-8} \text{ volts.}$$

If we neglect the resistance of the circuit in comparison with its inductance, we have

$$\text{power absorbed} = N \frac{d\phi}{dt} \times i \times 10^{-8} \text{ watts.}$$

If A, l be respectively the area and length of the magnetic circuit, we also have

$$\begin{aligned}\phi &= BA\\ &= \mu HA,\end{aligned}$$

the symbols having the usual significance.

$$\text{Again } H = \frac{4\pi}{10} \times \frac{Ni}{l}$$

$$\therefore \ \phi = \frac{4\pi\mu}{10} \times \frac{NiA}{l}$$

$$\therefore \ i = \frac{10}{4\pi N} \times \phi \times \frac{l}{A\mu} \text{ amps.}$$

$$\therefore \text{Power} = N\frac{d\phi}{dt} \times \frac{10}{4\pi N} \times \phi \times \frac{l}{A\mu} \times 10^{-8} \text{watts.}$$

$$= \frac{l}{4\pi A\mu}\,\phi\,\frac{d\phi}{dt} \times 10^{-7} \text{ watts.}$$

Assuming constant permeability, the total energy communicated to the field when it has attained its maximum value ϕ, say, is

$$\frac{l}{4\pi A\mu}\int_0^{\phi} \phi\frac{d\phi}{dt}\,dt \times 10^{-7} \text{ watt-secs.}$$

$$= \frac{l}{4\pi A\mu} \times \frac{\phi^2}{2} \times 10^{-7} \text{ watt-secs.}$$

$$= \frac{l}{8\pi A\mu}\,\phi^2 \text{ ergs.}$$

$$= \frac{1}{\mu}\,\frac{B^2}{8\pi} \times lA \text{ ergs.}$$

$$= \frac{1}{\mu}\,\frac{B^2}{8\pi} \text{ ergs per cubic cm.}$$

This result is well known and from it the tractive force of an electromagnet may be immediately deduced. It must be pointed out that the above proof is only legitimate for a uniform magnetic circuit with definite boundaries. The presence of the factor 4π is due to the way in which the unit magnetic pole is defined, and from which it follows that unit pole has 4π lines of force. If we adopt Heaviside's system of units, in which unit pole is defined as that which repels an equal and similar pole with a force of $1/4\pi$ dynes, then the factor 4π disappears and a simplification of many formulæ results. This course has not, apparently, been generally followed.

Thus, whenever the number of lines of force threading a magnetic circuit changes, B changes, and hence the energy of the field is altered. If the number of lines increases, the magnetising current must increase so that more energy is drawn from the supply. If B is reduced, the energy is reduced, and the balance is dissipated in the form of heat, etc. This is brought about by means of a prolongation of the original current through the mechanism of an induced EMF, which is directly due to the energy change. Although the law governing the production of an induced EMF was first obtained by Faraday on experimental grounds, this law may be deduced directly from the principle of the conservation of energy: but with this we are not at present concerned.

(To be continued.)

Congratulations.—The Council of the I.E.E. have elected Sir Oliver Lodge, D.Sc., F.R.S., to be an honorary member of the Institution.

Reviews of Books, &c.

[Books noticed in this column will be sent from ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

BRITISH STANDARD SPECIFICATIONS FOR FUELS FOR HEAVY-OIL ENGINES (PETROLEUM AND SHALE OILS) (No. 209-1924.)—This 16-page pamphlet is one of the first-fruits of the Sectional Committee on Petroleum Products recently set up by the B.E.S.A. In it specifications are given for four grades of fuel oil, the first grade being a gas oil and the other three being non-distillate oils, all classes of heavy-oil engines thus being catered for by one or other of the four grades. Users of heavy-oil engines should satisfy themselves, by test or otherwise, which of the four grades of oil specified can most satisfactorily be utilised in any given engine, and the corresponding specification should then be adopted. There are one or two points of special interest in these specifications, as follows:—

(*a*) No mention of specific gravity is made. In the past many specifications have called for a definite specific gravity and a definite viscosity, but the conclusion has been reached that it is quite unecessary to specify the specific gravity of a fuel oil provided the viscosity characteristics are clearly defined.

(*b*) The sulphur content is not specified. While drawing up these specifications every effort was made to obtain evidence to prove that the harmful effects attributed to oils in certain cases were due to the sulphur in the oil. Pending the production of such evidence it has been decided that, in the case of fuel oils for heavy-oil engines as distinct from fuels for use under boilers, a test for sulphur unnecessarily increases the cost of the oil.

The specifications will be revised, if necessary, in twelve months' time.

The methods of testing the oil given in these specifications are those adopted by the Institution of Petroleum Technologists, and are described in detail.

Copies may be obtained from the B.E.S.A. Publications Department, 28, Victoria Street, London, S.W.1, or from ELECTRICITY office (S. Rentell and Co., Ltd.), price 1s. 2d. post free.

MICHAEL FARADAY. By Wilfred L. Randell. 187 pp. (Leonard Parsons, 4s. 6d. net.)—We commend most heartily to our readers this excellent account of the early struggles and later achievements of the man who may truly be said to have laid the foundation-stone for the whole of the vast edifice of present-day electrical engineering. No one who has not already studied the life of this pioneer can appreciate the state of scientific knowledge (or ignorance!) which existed in the earlier years of Faraday's life, yet when he died in 1867 the modern era had more than dawned and, though many have added to Faraday's work, no errors of any moment have been found in the results of his labours and no additional discoveries of such far-reaching importance have been made. The tale of Faraday's life is told by Mr. Randell in words which engage and hold our sympathy and our imagination. We see and live with the bookbinder's apprentice who was content to take the lowliest post in the laboratory of which he was destined to become the brilliant chief, respected throughout the world and famous for all time. We find him toiling year after year at the limits of physical endurance, regardless of the wealth which might have been his, seeking only for knowledge, but ever mindful of, and contributing towards, the needs of others. Those who profess to regard science and religion as being incompatible will find no support in the life and views of Faraday, whose faith was deep and unshaken to the last. From these and many other points of view Mr. Randell deals most admirably with his subject, giving us in small compass and at nominal cost a vivid and faithful portrait of one in whom every electrical engineer must be keenly interested, if only for reasons of common gratitude to the man who founded his profession. One of the many interesting features of this book, which we again commend very earnestly to our readers, is a series of letters addressed to Faraday by Charles Dickens and now published for the first time.

LONDON UNIVERSITY GUIDE AND UNIVERSITY CORRESPONDENCE CALENDAR. 207 pp. (University Correspondence College, gratis.)—We have pleasure in bringing to the notice of our readers the reappearance of this useful annual, publication of which has been suspended since 1915. By the present generation of students the guide will probably be regarded as an innovation, but thousands of those who have passed through the scholastic mill will remember with gratitude the assistance they received from this work in days gone by. This is, we believe, the only book giving regulations and syllabuses for all the examinations of the University of London, together with advice as to appropriate text-books to be used in preparing for these examinations. The work is therefore of the highest interest and value to private students, teachers and educational officials. The education required to pass University examinations, and the " hall mark " acquired by having done so, are more than ever necessary and valuable in these days. The external system, which gives the University of London a unique position, enables many students to qualify who could not otherwise realise their ambition and that excellent institution, the University Correspondence College, has rendered incalulable services by helping students to avail themselves of these facilities.

THE BROADCASTING TIMETABLE AND RECEPTION LOG. Compiled by Ronald Grierson. (Chapman and Hall, 2s. 6d. net.)—The importance of keeping a record of the conditions and settings of receiving apparatus, when listening to distant stations particularly, cannot be too strongly emphasised, and it is of great help in tuning these distant stations in on any future occasion when it is desired to receive them, and by reference to records, interference to near-by stations is to a very great extent removed, as it is then not necessary to oscillate with a view to picking up a carrier wave.

The tables are very complete and novel. The station names, call signs, frequency, wave-length, and power are given in columns placed against a special chart shewing Greenwich mean-time. The definite times for transmission are shown by lines cutting the vertical Greenwich mean-time lines, the definite transmissions being shown with a black line, and intermittent transmissions—that is, those not definitely fixed for time—are shown by a dotted black line. It is therefore possible to run down any of the lines representing time and to see exactly the stations that may be expected to be working, and this is done with the least possible delay and the minimum amount of trouble. On the opposite pages to these tables and chart is a reception log, which has spaces for practically all information likely to be of any service. There is also a column for remarks, some of which are very helpful when it is desired to tune in distant stations. For instance, against London, on a wave-length of 365 metres, it is pointed out that this wave-length is useful for tuning "K.D.K.A.," as K.D.K.A.'s wave is the fourth harmonic of the London station.

The list of stations covers the British Isles and Europe, and such American stations as are likely to be received. A map of the world is given, on which the main towns are marked, and their approximate distances from London may be calculated. Another map gives circles drawn from London, and this is very useful in determining distances of British and Continental stations. A further map shows the British Broadcasting Company's stations, and gives circles of 30- and 60-mile radii from the principal broadcasting stations.

The book contains other valuable information, such as tuning coil data, receiving valve operating data, particulars of wireless time signals, notes on reception and maintenance of equipment, the location and elimination of faults, and on the last sheet has a log on which the reception of amateur stations may be noted and recorded. It provides a very useful means of accurately and quickly noting down these details very necessary for the serious operation of an amateur wireless receiving station.

ELECTRICAL DESIGN OF OVERHEAD POWER TRANSMISSION LINES. By William T. Tayler and R. E. Neale. (Chapman and Hall, 21s. net.)—This book deals with the electrical characteristics of overhead transmission lines up to 60 miles in length, and operating at voltages not exceeding 60,000. These limits rule out cases which require the use of hyperbolic functions for line calculations. The mechanical design of transmission lines is not dealt with. The book commences with an able and thorough exposition of the basic principles underlying the whole subject of transmission line calculations. Elaborate data are then given for the computation of area, weight and cost of conducters, and of impedence regulation and power loss. The effect of power factor is considered at length, and alternative bases for design are worked out in detail. Elementary mathematics only are used, and great prominence is given to actual numerical calculations. The outstanding feature of the work is the immense amount of data given in the form of tables and charts for facilitating numerical calculations, and we think that the book would have been improved if a list of these tables and charts had been given at the beginning. The chapter on power factor and power factor correction does not seem to be well balanced. The treatment of power factor correction, especially as regards its economic aspect, is rather slight, and we think that the treatment of the effect of power factor on line characteristics might probably have been somewhat condensed to allow a fuller exposition of the important matter of power factor correction. The value of the book is considerably enhanced by numerous cross references, and there is a good index. In conclusion, the book can be thoroughly recommended as one that will be of the greatest use to engineers and consultants who have to deal with transmission line problems; it will also be of considerable service to the advanced student, but the highly specialised treatment and the lack of descriptive matter will render it of somewhat limited interest to the general reader.

B.E.S.A. PUBLICATION NO. 125—1924. HARD-DRAWN COPPER SOLID AND STRANDED CIRCULAR CONDUCTORS FOR OVERHEAD POWER TRANSMISSION PURPOSES. (1s. 2d. post free).—The data in this specification are based on the results of extensive tests on hard-drawn copper conductors carried out by the British Electrical and Allied Industries Research Association and also by the National Physical Laboratory, and are of considerable interest in that they are the first authoritative data to be published in this country on hard-drawn copper conductors. Four tables are included in the specification, two of these dealing with solid (single) conductors, and two with stranded conductors. In each case two series of standard sizes are given, a primary series for use whenever possible, and a secondary series for use when it is impracticable to use the primary sizes. The committee responsible for this specification has adopted these two series of sizes in the hope that the secondary sizes will eventually fall into disuse and that the primary sizes will then be used in all but very special cases. Mechanical and electrical tests are specified for all sizes, as are also the weights per 1,000 yards and per mile. This specification is of special importance in view of the regulations for overhead lines prescribed by the Electricity Commissioners, wherein it is stated that "all line conductors at the time of erection shall comply, as regards elongation, breaking load and elasticity with the specification of the British Engineering Standards Association then in force."

Meetings.—The I.E.E. will meet at the Institution, Savoy Place, Victoria Embankment, W.C.2, on Thursday, Dec. 4, at 6 p.m. Lecture on "Gyroscopic Pendulums," by Prof. J. G. Gray, D.Sc., and Mr. J. Gray.

Exhibition.—The D.O.T. has recently received particulars of an exhibition of hydraulic power and touring to be held at Grenoble from May to October next year. It enjoys the official patronage of the French Government, and its general aim will be the advertisement of the great progress made during recent years in the use of hydraulic power not only in the production and distribution of electricity, but in its adaptation to the needs of modern domestic life and transport. The exhibition grounds, covering fifty acres, are within a few minutes of the centre of the town, and U.K. firms will be able to exhibit in the general buildings, which may be briefly classified as devoted to production of power, application of power, touring (including sports), and transportation. Full particulars from the Exhibition and Fairs Division, D.O.T., 35, Old Queen St., London, S.W.1.

South Africa.—The report on the Economic Conditions in South Africa has just been published by the D.O.T., and may be obtained from H.M. Stationery Office or ELECTRICITY Office, price 1s. 8d., post free. In it there is a section dealing with electrical development in the Union, which has made a long step forward in the past twelve months, and much of which should be in operation this year. Reference is also made to the competition in the importation of electrical plant and machinery. Almost all classes of electrical machinery and goods show an increased German trade in 1923, the bulk of which is at the expense of Great Britain. The American electrical trade with South Africa is also increasing, and it is therefore of importance that British export firms should give this matter their close attention.

Trade Notes.

From the **Damard Lacquer Co., Ltd.**, Warwick Road, Greet, Birmingham, we have received circulars dealing with "Formite," which is the title they have given to the Bakelite synthetic resin products in which they are specialising. The list gives clear details of its general properties and applications, and will therefore appeal directly to all who are interested in the manufacture of electrical apparatus in which insulating materials form an essential portion. Another circular deals with economical disc grinding, in which the formite is used as an abrasive disc cement, and this will appeal to works managers, engineering shop superintendents, foremen, etc. The lists should most certainly be written for.

Messrs. A. H. Hunt, Ltd., of Tunstall Road, Croydon, announce that they have now almost entirely reorganised their machine and assembly shops with a view to be in a position to take up repetition work, press work, blanking, bending and assembling small articles for the trade. They have already secured a large volume of business in this direction, but are naturally anxious to receive further inquiries.

A splendidly illustrated 72 pp. catalogue of supplies for electrical contractors has just recently been issued by the **British Insulated and Helsby Cables, Ltd.**, of Prescot, Lancs. It contains a very large amount of information which will be of direct interest not only to the electrical contractor himself, but also to installation engineers, foremen and others who will make practical use of the goods listed in the course of their daily business routine. There is a clear description of the Prescot Twin house-wiring system, tables of fuse wire, instrument wires, insulators, cleats, fuse boxes, cable racks, cable accessories, jointing compounds, wireless aerials and aerial fittings, lightning conductors, incandescent lamps and primary batteries. Altogether a very comprehensive list which will add to the reputation of the firm by whom it is published.

From the **Constructional Engineering Co.**, of Titan Works, Charles Henry Street, Birmingham, comes a circular descriptive of their new Titan Cupolette, together with an illustration thereof, showing its convenient size and the connection with the electrically driven fan. It should be of direct interest to all engineers using their own foundries and desirous of obtaining small castings with the least possible delay. For repair shops generally it should prove invaluable.

List L324 which has just been issued by the **B.T.-H. Co., Ltd.**, of 77, Upper Thames Street, London, E.C.4, gives details of the B.T.-H. wiring accessories and their electrical supplies generally. It will, therefore, appeal to all installation contractors, to whom it will willingly be sent on application. Another list issued at the same time explains what the company are doing in the way of creating a demand for their radio valves, and yet another folder gives illustrations, details and prices of the valves themselves. These latter will. of course, interest all dealers in wireless supplies.

List 414, which has been issued by the **Sun Co.**, of 120, Charing Cross Road, London, W.C.2, gives prices and full particulars of standard makes of vacuum, gasfilled, carbon, etc., lamps for all purposes, of which the company hold good stocks, and are therefore prepared to supply the trade at market prices without delay. It should interest all retailers of electrical goods as well as installation contractors, etc.

A very handsome quarto catalogue of switchboards and switchgear has just recently been issued by the **G.E.C.** It is the fourteenth edition of Section X. (1), and gives voluminous details, diagrams and illustrations of the latest types of H.T. cubicle gear, low and medium tension A.C. boards, feeder control cubicles, oil-immersed flame-proof boards, direct-current switchboards, and, in fact, all the switchgear which may be required for installations of the most varied descriptions. It will therefore prove of direct business value to every central-station engineer who is finding it necessary to extend his plant, as well as to installation contractors, power engineers, consultants, and leading members of the trade generally. It is produced with all the care and exactitude which one associates with G.E.C. publications, and is therefore certain to be appreciated accordingly.

Leaflet Wireless 82, which has just been issued by the **Enterprise Mfg. Co., Ltd.**, of Grape Street, London, W.C.2, gives prices and particulars of their "Super-Perfect" Wireless Components, including their Micrometer Filament Dimmer, Variable Grid Leak, Variable Anode Resistance, and "Emcite" Crystals, all of which will appeal to dealers in wireless supplies generally. Copies of the list will willingly be forwarded on application.

A NOVEL METHOD OF STARTING POLYPHASE SYNCHRONOUS MOTORS.*

BY E. V. CLARK, B.Sc., Associate Member.

(Paper first received November 19, 1923, and in final form March 31, 1924.)

SUMMARY.

This paper records that while some difficulty may ordinarily be experienced in starting up a polyphase synchronous motor simutaneously with the alternator supplying the circuit, the difficulty is greatly reduced if the alternator is of the asynchronous type; and that with small laboratory plant this method of starting is simple in the extreme.

Further, if the asynchronous alternator has a wound rotor and an adjustable rheostat in its rotor circuit, then the synchronous motor may be run up to speed by the operation of the rotor rheostat, with the asynchronous alternator running at full speed throughout.

A scheme for operating small synchronous motors in a factory with this method of starting is outlined as being technically feasible, though inferior to other methods in general convenience, and, therefore, devoid of much commercial utility.

Three fields where this method of starting may be of appreciable or occasional use are cited, viz., technical school laboratories, testing-shops of manufacturers, and emergency use by supply authorities.

A standard method given in the earlier textbooks for starting a synchronous motor is to run it up with the alternator, *i.e.*, to connect it electrically to the alternator while the latter is at rest, to excite both alternator and motor, and then to start the alternator very slowly, giving the motor a start by hand. The motor should come into synchronism and thereupon the alternator may be gradually raised in speed, bringing the motor up to speed with it. The author's students attempt each year this method of starting a synchronous motor in the electrical engineering laboratory of the Adelaide University, but with very little success, as the conditions are unfavourable. The two three-phase machines available for the experiment have very different waveforms, and one has to be considerably under-excited when they are used in conjunction. Thus the synchronising force at low speed is small, and the motor readily falls out of step if the alternator is accelerated at all rapidly.

It would appear that an asynchronous alternator should be much more suitable for use with this method of starting, since the motor would completely determine the voltage and periodicity of the circuit; while irregularity of the acceleration of the alternator would only mean irregular negative slip, and the torque on the synchronous motor would always be positive. Thus, if once the motor is properly running there should be no tendency for it to slow down and come to rest, unless the alternator is accelerated so rapidly (having regard to the inertia of the motor) that the negative slip becomes great enough to reduce the torque below that necessary to overcome the no-load losses of the motor.

Experiment showed this to be the case. There is very little difficulty in starting up the laboratory 5 kw. three-phase alternator as a synchronous motor when power is supplied to it electrically by a 2 h.p. three-phase induction motor, used as an asynchronous alternator and belt-driven from a D.C. motor. This induction motor has a wound rotor which may be short-circuited for the experiment. The synchronous motor is excited, the switch connecting it to the synchronous alternator is closed, and the motor driving the latter is then started. As an asynchronous alternator has no power of self-excitation, it follows that no current flows between it and the synchronous motor. But if, as the synchronous alternator is started, a moderate hand-turn is given to the synchronous motor, this at once generates an E.M.F. and produces sufficient current both to excite the asynchronous alternator and to keep the motor running. The alternator may now be run up to speed quite rapidly, and the motor will follow with no tendency to "fall out."

With the provision of an asynchronous alternator with wound rotor and three-legged rheostat in the rotor circuit, however, it is not necessary to start up the synchronous motor at the same time as the alternator, since the latter may run at full speed throughout the starting operation. The alternator, not being self-exciting, may be connected electrically to the synchronous motor by closing the main switch, without any circulation of current. The motor is excited and the alternator rotor rheostat is placed on the first notch as if the alternator were being started up as an induction motor. And now, by giving a hand-turn to the synchronous motor, E.M.F. is generated, current flows, and the motor runs up to a speed corresponding roughly to that which would be attained on the first notch of the starting rheostat if the asynchronous alternator and synchronous motor were reversed in position. Also, by cutting out the resistance in the alternator rotor circuit notch by notch, the synchronous motor runs up to speed without any excessive rush of current, only a small kick being observed as each succeeding notch is used.

The simple and easy starting of a synchronous motor in these circumstances is just what one would expect from theory. The torque of an induction motor, for a given rotor resistance, flux and slip, is the same except for sign, whether the slip is positive or negative. Hence if the starting torque of a 50-cycle 4-pole induction motor at rest—*i.e.*, when the slip is 50 cycles per second—on the first notch of its starting rheostat is T, then if we mechanically drive the induction motor at 1,550 r.p.m. and have electrically connected to it a 4-pole synchronous motor running at 50 r.p.m., we have a negative slip of 50 cycles per second and a torque of $-T$ with the same rotor resistance in circuit, provided the flux is the same in the two cases. But on a purely inductive circuit, a synchronous alternator of negligible internal resistance gives a constant current irrespective of speed, since the E.M.F. generated and reactance both vary as the speed. Hence as the resistance in the circuit comprising asynchronous alternator stator and synchronous motor armature is small, quite a small speed of the synchronous motor will cause a considerable current to flow and thereby produce the necessary flux.

(To be continued.)

---

* Paper read before the I.E.E.

Various Items.

The Society of Engineers.—The annual general meeting will be held at 6 p.m. on Monday, Dec. 8, in the offices of the Society.

Quotations Wanted.--The Municipality of George, Cape Province, invites tenders for the supply and installation of an Electric Light and Power System of 100 kw. capacity. Specifications, etc., can be seen by British firms interested at the D.O.T. (Room 52), 35, Old Queen Street, London, S.W.1.

Demand for Electrical Appliances.—Electrical appliances have recently been in good demand in Canton, according to Mr. W. R. M'D. Parr, Commissioner of Customs at Canton, in his 1923 report. Most of this trade goes to German firms. Prominent items are fans, smoothing irons, electric kitchen utensils, passenger lifts, dynamos and motors.

Egypt.—The Municipalities and Local Commissions Section of the Egyptian Ministry of the Interior, Savoy House, Cairo, are calling for tenders for the supply and installation of the equipment for an electric power station and distribution system for the town of Mellawi. Specifications in French and plans may be seen at the D.O.T. (Room 52), 35, Old Queen St., S.W.1.

Newry (Co. Down).--At a meeting of the Electricity Committee of the Urban Council recently it was decided to report to the Council in favour of proceeding with the proposed municipal electricity scheme (alternate current system to be adopted), and of making arrangements for the appointment of an engineer in connection with the carrying out of the scheme.

Liffey Water Power.—The Joint Committee fixed November 25 as the date on which the formal examination of the private Bills concerning River Liffey hydro-electric schemes will begin. The Bills referred to are the Dublin Electricity Supply, the East Leinster, and the Dublin and District Electricity Supply (Dublin Corporation's Bill). Various objections have been lodged, and the objectors will be heard.

South Africa.—At the meeting of the S.A. Inst. of Elec. Engrs., held at Johannnesburg on September 18 last, Major E. F. Rendell, M.C., read a most interesting and comprehensive paper on "The Control Organisation of the Victoria Falls and Transvaal Power Co., Ltd." It is reprinted in full in the September issue of the "Transactions of the Institute," along with numerous illustrations and diagrams, which add materially to its value.

Meetings.– The Junior Inst. of Engineers will meet to-night, Friday, 28th inst., at 39, Victoria St., at 6.30 p.m. Exhibition of latest scientific instruments and appliances for the use of engineers. Also, on Friday, Dec 5, lecturette, "Metal Cutting Under Water by the Oxy-acetylene Blow Pipe," by J. B. Polland (slides and demonstrations). And on Friday, Dec. 12, paper, "Fluid Transmission Gears," by H. G. Bouly (slides), both at 7.30 p.m.

World's Second Largest Graving Dock.—The large graving dock nearing completion at Durban is expected to be opened next March. Ships will be manœuvred in and out of the dock with the aid of six 15-ton electric capstans, now being placed in position by the makers, Vickers, Ltd., Barrow-in-Furness. The dock, when completed, will be the world's second largest, and will help to make Durban one of the finest ports in the Southern Hemisphere.

South Wales Engineering Exhibition.—Among the leading displays at this exhibition, now open at Cardiff, we think many of our local readers will find much interest in the exhibit of the Underfeed Stoker Co. Ltd., which includes an actual installation of the new "Underfeed Type C." laminated belt water-cooled travelling grate stoker, a section of the "Usco" air-heater, and a very large model of the well-known "Raymond" mill for pulverised fuel.

Tenders Accepted.—John Thompson Water Tube Boilers, Ltd., have secured a contract from Vickers and International Combustion Engineering, Ltd., for two of their patent vertical straight tube water tube boilers, each having 9,000 sq. ft. of heating surface, and suitable for 275 lb. working pressure, for Synthetic Ammonia and Nitrates, Ltd., Billingham, Stockton-on-Tees. These boilers are to be fired with powdered fuel by the "Lopulco" system.

West Midlands Electricity District.—The Draft Order constituting this district and giving details thereof has been issued by the Electricity Commissioners, and copies may be obtained by interested parties on application to the Secretary at Gwydyr House, Whitehall, London, S.W.1. They also give notice of their intention to hold a local inquiry in the Town Hall, Wolverhampton, on Tuesday, December 16, and following days with reference to the scheme and to determine the area.

"**The Loudspeaker.**"—We have before us No. 1 of this new monthly, which is the house organ of the Peel-Conner Telephone Works at Coventry. It is a brightly edited magazine, and as there are now over 2,800 employees engaged in the factory it ought to have a wide field from which to draw contributions, as well as a remunerative sale. We wish it the best of good fortune.

Social.--Sir William Noble presided at the works dinner of the G.E.C. Peel-Conner Telephone Works, which was held in the Magnet Club Buildings, Stoke, Coventry, on Friday, November 21. He also proposed the toast of "The G.E.C.," which was responded to by Mr. Hirst, while Mr. M. J. Railing proposed "The Peel-Conner Telephone Works," and Mr. H. P. Wells replied. An excellent programme of music had been provided, and altogether it was a very happy evening.

Correct Time at Chesterfield.--The corporation of this town has recently shown its enterprise by arranging with Messrs. Gent and Co., Ltd., of Leicester, to synchronise the four public clocks, viz., the Market Hall, the Parish Church, St. Thomas's Church and Holy Trinity Church, and the installation was completed and opened on Saturday last. Current is furnished from the corporation tram depot, at which Greenwich time is received daily by wireless and synchronised to all the clocks on the system. The innovation is much appreciated by the inhabitants.

A Charitable Object.—The Lady Ashfield, with others, is engaged in arranging a ball, with supper and cabaret, in aid of the Infants' Hospital at Westminster. It will be held at the Café de Paris, 3, Coventry St., London, W.1, on Tuesday, December 9, next, commencing at 10 o'clock. Tickets, at 25s. each (including supper and cabaret), can be obtained from her ladyship at 43, South St., W.1; from Mrs. Leslie Gamage, at 110, Mount St., W.1; and from all members of the committee. Those unable to attend are invited to send a contribution towards the funds of the hospital.

Meetings.—The Wireless Section of the I.E.E. will meet on Wednesday, Dec 3, at 6 p.m. Paper: "Wireless Telegraph Valve Transmitters Employing Rectified Alternating Current," by G. Shearing (Member).——The Western Centre of the I.E.E. will meet at the South Wales Inst. of Engineers, Park Place, Cardiff, at 6 p.m., on Monday, Dec. 1. Paper: "Automatic and Semi-automatic Rectifier Sub-stations," by G. Rogers, illustrated by slides.——A meeting of the Birmingham Electric Club will be held at the Grand Hotel, Colmore Row, to-night (Friday, 28th inst.), at 7 p.m., when a lecture will be given on "Thermionic Valves," by Mr. G. A. Percival (the Edison-Swan Electric Co., Ltd., Ponders End) (slides).

British Industries Fair.—In view of the probable reopening of the British Empire Exhibition in 1925, it has been decided to suspend the London Section of the British Industries Fair, which would otherwise have been held from February 16 to 27. The Birmingham Section of the Fair will, however, be held as usual, and as a special measure for 1925 only, the Birmingham authorities have generously undertaken to organise sections in their Fair for those exhibitors who have hitherto shown in London, provided that the demand for space ensures the adequate representation of the industries concerned. The Department of Overseas Trade expects to resume the series of British Industries Fairs in London in 1926.

Sample Pair Sent on Approval for 8/6

Made of Pure Para Rubber, soft and durable and unaffected by climatic conditions
DAVID MOSELEY & SONS,
Limited,
ARDWICK, MANCHESTER.

MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
A PRACTICAL TRADE JOURNAL

DECEMBER 5, 1924.

CONTENTS.

PAGE
How B.T.H. Headphones are Made 661
Recent Developments in Illuminating Engineering 664
Lighting Government House, Singapore 664
Current Topics 667
Electric Passenger Lifts 668
Practical Electrical Engineering Hints 670
Questions and Answers by Practical Men 673
Junior Institution of Engineers 674
Knaresborough Electricity Undertaking 677
Reviews of Books 677
Various Items 678
Trade Notes 678

HOW B.T.H. HEADPHONES ARE MADE.

A VISIT TO THE BRITISH THOMSON-HOUSTON COMPANY'S COVENTRY WORKS.

The head telephone is a remarkable example of the way in which the design of a more or less standardised article can be rapidly adapted to new conditions and more exacting requirements. When headphones were used almost entirely for the reception of telegraphic signals, quality of reproduction and absence of distortion were not considered of great importance, and were given very little attention. The pre-war headphone was satisfactory enough for pre-war purposes, which did *not* include the faithful reproduction of high-brow concerts or the vocal gymnastics of orators and singers.

As a result of these changed conditions, the modern headphone is, or should be, a very different instrument from its pre-war prototype.

EXPRESSLY FOR BROADCAST RECEPTION.

B.T.H. headphones were designed expressly for broadcast reception. The designers were untrammelled by old prejudices or methods, and were not required to adapt their designs to existing machinery. As a result they represent a radical departure from earlier designs, and, what is of considerably more importance, are greatly superior in sensitiveness and tonal fidelity.

The B.T.H. engineers were in possession of one very valuable piece of previous experience when they started to make head-telephones. During the war they had had to tackle the problem of making magnetos for aeroplanes, and the experience gained has proved of immense value in the design of their headphones, with the result that the authorities have been able to combine the most careful testing and inspection with large scale mass production methods. The B.T.H. headphone is a scientific instrument of precision. At the same time it is a standardised article in universal demand, and the reconciliation of these two facts and their implications is intensely interesting to the student of industrial methods.

REALLY LIGHT-WEIGHT HEADPHONES.

The original pattern of B.T.H. headphones very rapidly achieved a remarkable reputation for sensitiveness and tonal quality, and since their inception, many improvements in details and construction have been embodied, so the company claim that present-day B.T.H. headphones are by far the most comfortable and convenient instruments of their kind on the market.

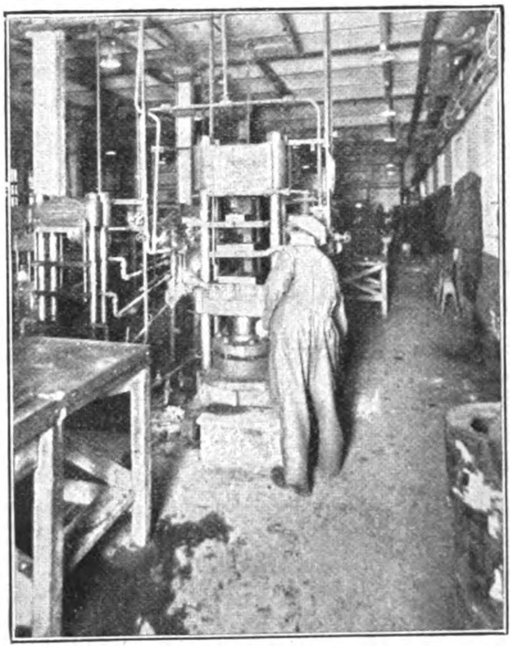


FIG. 1.—MOULDING BODIES AND EAR CAPS. VIEW SHOWING MOULDING PRESS.

They cannot catch in the hair because they have no projections and there is no "scissors" movement in the headband, they only weigh 9½ ounces (with cord), they fit just tightly enough to exclude extraneous sounds, but not tightly enough to be uncomfortable, and they can be adjusted to any head in a second by a

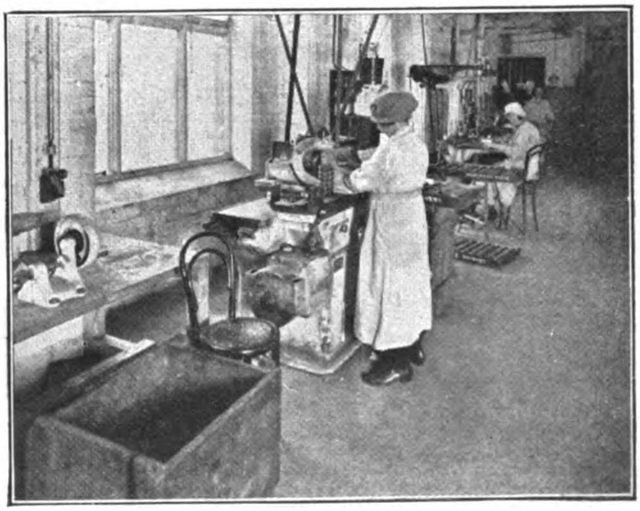


FIG. 2.—MACHINING OF HEADPHONE BODY.

single movement and without the manipulation of screws. They will detect the weakest signals and will not distort the strongest, they are perfect in tone and wonderfully sensitive. Each pair of headphones is supplied with five feet of cord, pin-tip ends, and a nickel-plated connector for connecting two or more sets in series.

SYSTEMATISED MANUFACTURE.

In the course of our visit to Coventry we were able to see for ourselves that considerable care has been taken in planning operations and in regulating the flow of work through the factory, so as to provide maximum output while maintaining adequate inspection and testing at all stages of manufacture and assembly. The manufacture has been reduced to a number of pressings and stampings, and assembly within a moulded container or earpiece. The number of constituent parts has been reduced to the minimum. There is not a single screw, stud or nut in the construction, and therefore nothing that can work loose in service.

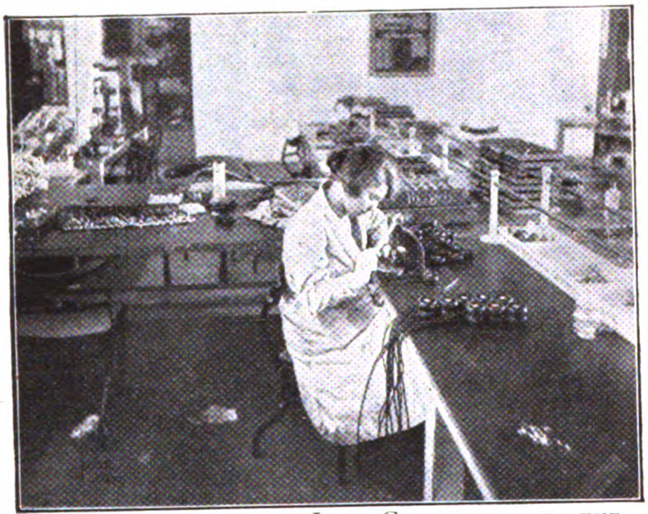


FIG. 3.—RIVETING THE LEAD CONNECTIONS TO THE HEAD TELEPHONE BODY.

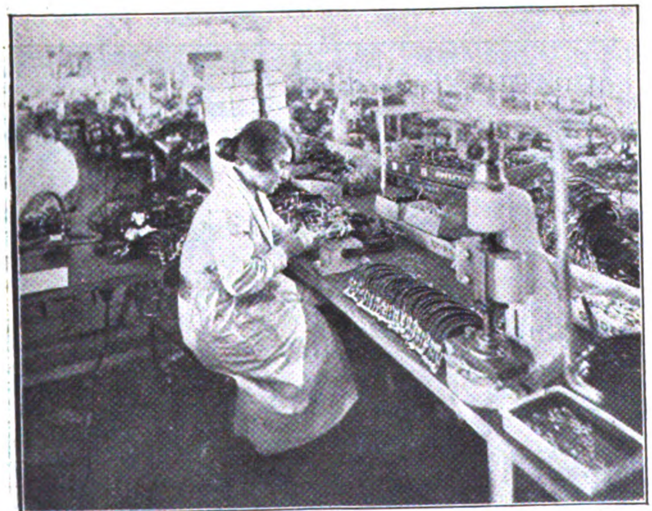


FIG. 4.—BENDING END OF STIRRUP TO PREVENT SLIDER FROM COMING OFF.

The sound box forms a single unit, and is made of non-resonating material or compound, into which the magnet and pole-piece assembly is embedded by means of a special moulding process operating under hydraulic pressure in a steam-heated press. The sound box is made of moulded composition manufactured on the premises. It is coloured a dark tan or chocolate, matches the leather headband and takes a high polish. This material is mechanically strong and will withstand the knocks, falls and other rigours of service. The earcap is made of the same material as the sound box and screws on to it. A stalloy iron diaphragm is clamped at its periphery between the earcap and sound box. *This method of clamping, whereby the diaphragm is tightly gripped around its periphery between the sound box and earcap, without the use of a metal ring, is a most important feature of the construction, and has much to do with the quality of reproduction.*

COBALT STEEL MAGNETS.

The oval hole in the slider which carries the wire stirrup stem attached to the earpiece is punched out of a sheet metal washer, which is ultimately assembled into the slider by means of a press and suitable jigs. Wire headbands and stirrups are bent to shape in presses with the aid of jigs. The method employed of mounting the stirrup stem in an oval bearing ensures that the stirrup and earpiece cannot be completely rotated, and consequently kinks and twists in the flexible leads do not occur. Press work is again called into play in the manufacture of the magnets, which are made of cobalt steel of specially high magnetic quality. Cobalt steel was selected after prolonged tests with other steels, and on the experience gained with cobalt steel in the manufacture of magneto magnets.

The pole-pieces are made from one stamping, which is cut to form two pole-pieces, these being assembled, by means of a press tool and press, to the permanent magnet. A grinding operation brings the pole faces to the right height, this measurement being duly tested in an inspection process. Every pole-piece is also subjected to a magnetic test. The pole-pieces are placed against pole-faces in a specially designed instrument and then withdrawn, the resultant kick on a ballistic galvanometer being an indication of the flux density of the pole-pieces.

WINDING THE COILS.

Careful design of the magnet coils ensures that the maximum number of turns are put into the available space. The spool itself is very thin, giving maximum space for the windings, and allowing the coil to be as close as possible to the pole-pieces. Very fine enamelled high-conductivity copper wire is used. For the outer layer a stouter wire is employed to provide a stronger lead for the connections. Each wire is tested for turns and resistance to ensure that the coils produced shall be uniform in magnetising effect.

As there are no outside terminals on the earpieces and, in fact, no screw terminals at all, the flexible cords are permanently attached to the inside connections.

Production engineers and those responsible for factory organisation would be very interested in the assembly department, which occupies a large room on the top floor of the factory. Specially designed benches have been installed to provide a correct working height for the operators, who are mostly women and girls. Each operator sits at her work on a backed chair.

GOOD LIGHTING HELPS OUTPUT.

One was particularly impressed by the high type of workpeople employed, their healthy appearance and the pleasing manner in which they answered questions. Supervision was evident but not obvious. The neat blue overalls worn by the workers and the bright scheme of decoration produced a very pleasant and cheerful atmosphere. Mazda gasfilled lamps and Mazdalux reflectors provide good general lighting, and, where very fine operations are necessary and there is any strain on the workers' eyes, additional bench spot lighting is provided. Thus the worker is helped, output increased, and spoiled work or faulty inspection reduced to an absolute minimum. The benches are so arranged that the workers are divided up into five sections or teams, each team producing completed headphones. The operations carried out in each of the five sections comprise spool insulating, cord winding, attachment of leads, coupling coils and connecting to tags, fitting coils to magnets, connection of flexible cords, fitting of diaphragm, fitting stirrups, testing and boxing. Each box bears a number, the numbering being done on a system that enables the date of boxing and the section that assembled the headpiece to be readily ascertained. Owing to the enormous daily output, the problem of quickly transporting the finished article to the despatch department has received most careful consideration. It has been solved by utilising a belt conveyor, and special means are provided for automatically indicating and registering the output of each team. Comparisons (odious and otherwise) can therefore be readily made, reasons for diminished output promptly investigated, and a competitive spirit is introduced between the various sections.

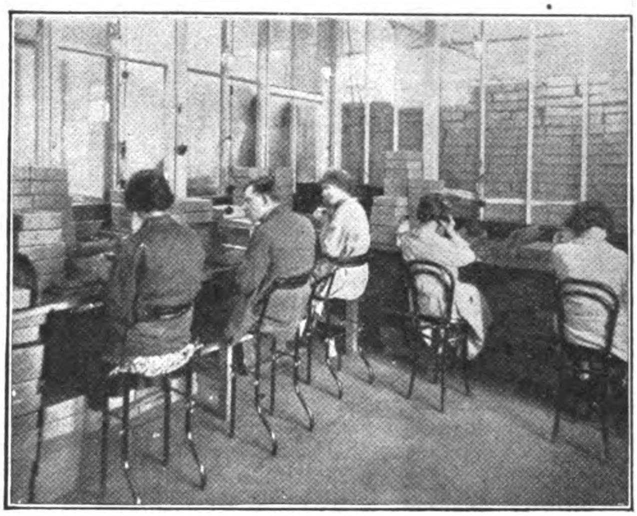


FIG. 5.—FINAL TESTING.

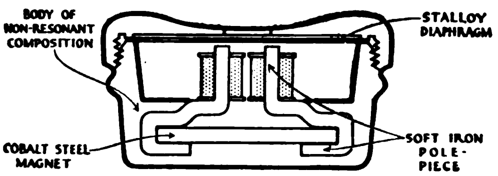


FIG. 6.—A CROSS SECTION THROUGH B.T.H. HEADPHONE EARPIECE.

THOROUGH AND IMPARTIAL TESTING.

In addition to continuity and resistance tests, each pair of phones is also tested for reception, particular attention being paid to the matching of the two earpieces. This is done by means of an electro-magnetic transmission device, music from a gramophone providing a substitute for broadcasting. A final test and inspection take place in the packing section of the stores department. Throughout the factory the various inspectors work under the direction of a chief inspector who is under the immediate control of the works manager. The individual inspectors are in no way responsible to the foremen. Inspection and, if necessary, rejection of parts or completed headphones, can thus take place without constraint or considerations of output. Research and development are continually going on in a special department, and although a most successful design has been obtained, there is evidently no intention of regarding it as being in any sense final.

One left with the impression that here was an example of a problem successfully solved on bold lines, and that there was sound reason for the remarkable popularity that B.T.H. headphones had obtained in a comparatively short time. Given ingenuity, initiative, and team work of the kind displayed at Coventry, there is little need for this country to go in fear of foreign competition.

In conclusion, cordial thanks are due to Mr. Sporborg and his co-directors for the opportunity afforded of visiting and inspecting a factory which bears every sign of successful organisation and management; and much credit is undoubtedly due to Mr. Young, the works manager, Mr. Gregory and other departmental chiefs for the way in which they are controlling and developing the whole undertaking, while the gentlemen who acted as guides rendered every facility in their power in explanations regarding machinery and processes. Finally, credit must be given to Mr. H. E. Goody, the publicity manager, for the pleasant way in which the visit was arranged and carried out.

An 8 pp. circular which has just been issued by **Ozonair, Ltd.**, of 96, Victoria Street, London, S.W.1, gives illustrations and particulars of the Ventex Air Filter, which is an entirely novel line and gives the most wonderful results in the way of freeing an air supply from dirt or other solid contamination. It should therefore appeal to all architects, sanitary engineers and others who are directly interested in ventilation and the supply of pure air to hospitals and buildings generally. Contractors should make a point of pushing this with their clients as it is very likely to attract orders.

A new circular which is now being issued broadcast to the trade from the offices of the **E.D.A.** at 15, Savoy Street, London, W.C.2, covers a direct appeal to suppliers and contractors to push electrical gifts this Christmas, and it is accompanied by a specimen pamphlet which, if used judiciously by such readers, should help very materially to increase their sales and, *inter alia*, to improve the central station load at the same time. It is a charmingly coloured printed 8 pp. list, all the items of which are directly suitable for gifts at the present festive season, and as the prices at which the circulars may be obtained from the E.D.A. offices are very moderate indeed, it is to be hoped that they will receive orders from the trade for very large quantities. At any rate, if any contractor or retailer has not yet received a copy of the circular, he should write at once to the E.D.A. and ask for particulars.

RECENT DEVELOPMENTS IN ILLUMINATING ENGINEERING.

At the opening meeting of the Illuminating Engineering Society, on November 18, Mr. L. Gaster gave the usual account of progress during the vacation. There have been many interesting events: the World Power Conference, the meetings of the International Congress on Industrial Hygiene and of the International Illumination Commission in Geneva, and the Conference on Illuminating Engineering at the British Empire Exhibition on August 12. The Congress at Geneva provided a good opportunity of interesting hygienists in illumination, and a resolution was passed recognising good lighting as an indispensable element in health, safety and efficiency. At the International Illumination Commission a large number of papers were read, and it is evident that the work of the Commission is extending. A feature of the proceedings this year was the attention devoted to the practical side. The papers read by Messrs. Lieb, Merril and Powell showed how manufacturers and supply undertakings combine their efforts in educational work in the United States, and how both find a rallying point in the Illuminating Engineering Society. All this formed a fitting prelude to the Conference on Illuminating Engineering. An account of the proceedings at this Conference has already appeared in Electricity. It may be recalled that one of the most important steps was the passing of a resolution approving the desire of the Society to initiate a widespread scheme for promoting public appreciation of the benefits of good illumination.

The subsequent report of the Committee on Progress in Electric Lamps and Lighting Appliances referred to the education of the public towards demanding higher standards of illumination, the popularity of the "all-white" lamp, and the B.E.S.A. specification. Steady development is recorded in floodlighting, show window lighting and spectacular lighting of various kinds, and attention is drawn to the formation of the E.L.M.A. Lighting Service Bureau.

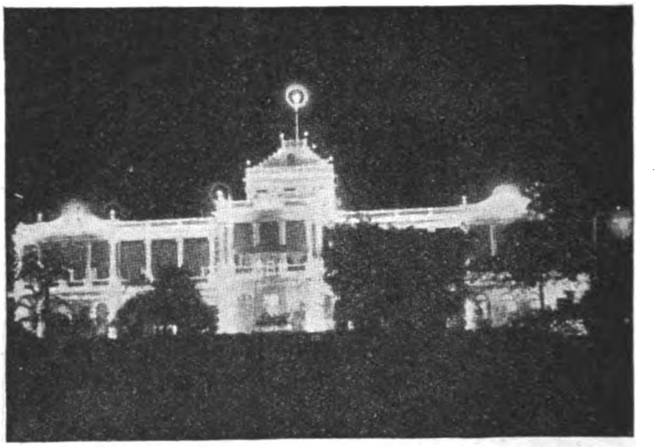
An address was delivered by Mr. W. G. Raffè on "The Psychology of Illumination," and Miss Mary Wurms dealt with "Stage Lighting in Relation to Music." An interesting point raised by Mr. A Cunnington was the lighting up of roofs and the upper parts of walls in main railway stations, so as to produce a more cheerful effect. From the standpoint of pure "efficiency" the direction of all the light downward is sometimes demanded; but experience shows that the public dislikes complete overhead darkness.

There were a number of interesting exhibits, including new lighting fittings shown by The General Electric Co., Ltd., The British Thomson-Houston Co., Ltd., and Benjamin Electric, Ltd., and Major A. Garrard demonstrated the latest type of "Moonbeam" anti-dazzle motor-car headlight. A pleasing form of illuminated sign exhibited by Mr. E. T. Ruthven Murray could be operated by a portable battery, and was therefore especially suitable for motor-car garages, etc.

In conclusion, it was announced that the next meeting would be held on December 16, when an invitation had been conveyed to members to visit the E.L.M.A. Lighting Service Bureau. Negotiations were in progress for a similar demonstration of developments in gas lighting.

LIGHTING GOVERNMENT HOUSE, SINGAPORE.

The annexed illustration conveys a good idea of the splendid effect of the illumination of Government House, Singapore, on the occasion of a ball, which was held in honour of H.M. the King's birthday on June 3 last. It was obtained by the use of large quantities of Osram gasfilled lamps of various wattages, the smaller sizes being employed for outlining the building and the high wattage lamps being used at the highest points.

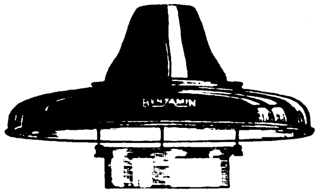


The beauty of the decoration was apparent immediately the lamps were switched on, the outline of the building appearing in multitudinous points of light against the blackest of night skies, while the general effect was enhanced when the whole building was bathed in light from numerous G.E.C. flood-light projectors and gasfilled lamps.

An Extra Meeting.—An extra informal meeting of the I.E.E. has been arranged to take place on Monday, December 15, at 7 p.m., to discuss the new Wiring Regulations of the Institution. The discussion will be opened by Mr. F. C. Raphael.

Dublin.—A joint Committee of the two Houses of the Free State Parliament sat in Dublin on the 25th ult. to consider three separate measures, all proposing the utilisation of the River Liffey for developing electricity. It is estimated that the preparation of these schemes and their presentation to the Committee has cost over £25,000, in addition to a further sum of £50,000 which the promoters under Standing Orders have had to lodge with the Ministry of Finance. Of the three schemes the East Leinster Bill proposes to supply the largest area, which includes the city and county of Dublin and large portions of Counties Kildare and Wicklow. It involves the construction of a lake at Poulaphouca to cover nearly 5,000 acres—an area equal to many times the extent of the Phœnix Park. The construction work will involve the building of one embankment about 100 feet high and 200 feet wide. From this reservoir the impounded water will pass through a short tunnel and aqueduct from Poulaphouca to Ballymore-Eustace. a mile distant, and lying at the foot of a steep decline. The principal power-station will be at Ballymore-Eustace, from which the flow of the Liffey will be controlled until it reaches Leixlip, several miles nearer the city. At Leixlip smaller reserves of water will again be impounded and another large power-station erected. Both of the power-stations will be connected with each other and with the city—and other points where supplies of electric current may be required—by means of overhead cables carried on steel towers. The intention of the promoters is to supply current "in bulk" to the Corporation of Dublin and other distributors and wholesale users of electric power. The capital of the company has been fixed at £1,200,000, and powers have been taken to increase it to £1,500,000. The local authorities will have representation on the board and a voice in the management.

Brilliant Light Without Glare
The BENJAMIN BIFLECTOR



The latest contribution to scientific illumination.

Ideal for Spinning Frames, Weaving Looms, Compositors' Frames, Offices, Schoolrooms, Hospitals, etc., etc.

Advt. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited, and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL & Co., LTD., 36–39 Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

The Courage of His Convictions.

It has often been urged, and with good reason, that everyone engaged in the electrical industry should so far as is practicable spread the gospel by making the fullest possible use of electricity in his own household. A Glasgow Professor of Electrical Engineering at the Royal Technical College, Prof. Parker-Smith, has entered into the spirit of this precept and has equipped his house throughout for electrical service, using neither coal nor gas. In the circumstances, his experience is interesting. It is a new house and has been occupied for eighteen weeks. The electrical arrangements are to the Professor's own specification. The apartments include a library, dining-room, drawing-room, five bedrooms, a kitchen and a nursery. The kitchen is equipped with an electric cooker and an electric washing machine, which dispenses with any manual labour in cleansing clothes. A drying-closet is fitted with an electrically driven exhaust fan, which draws in the air and heats it in the process so that drying can be completed in an hour.

Provision is made for filtering all air, when necessary, and fittings provide for the extraction of solid particles from the air. A cupboard contains an electrically heated warming-plate, which can be used for pre-heating dishes and keeping food hot. The electric cooker is disposed at table height, and does away with all tiresome stooping. External chimney breasts are used as air ducts for heating and ventilation, the polluted air being extracted from the rooms and fresh air being drawn in through apertures in the fireplace recesses, which are equipped with electric fires. Convenient wall sockets abound throughout the house for the attachment of vacuum cleaner, portable lights, irons, kettles, etc. The hot-water problem is overcome with the aid of a ninety-gallon tank in the bathroom. Electrical energy for heating this mass of water is switched on at 11 p.m. and switched off again at 7 a.m. by time switch, a meter incorporated with which records the number of units consumed. The hot water thus obtained is ample for household requirements, and the current is available during these times at special low rates.

There has been no hitch in these arrangements, reports the Professor, everything working with success. The capital costs naturally come out higher than those for corresponding gas and coal, but the running costs are fairly moderate. In fact, the average for the eighteen weeks during which the electrical installation has been in daily service works out at 14s. 7d. per week for all purposes, the period under review being that from July to November, during the latter portion of which, no doubt, the electric fires would be in service. Taking into account the labour saved, the cleanliness incidental to electrical service, its general convenience and many advantages, this weekly expenditure cannot be regarded as excessive, and testifies to the attractive rates prevailing in the Glasgow area.

A Wembley Idyll.

Now that the curtain has finally fallen on the 1924 British Empire Exhibition, some interesting light is being thrown on one or two mysterious happenings which were shrouded in obscurity whilst the show was open to the public. Among other things, many people would be interested to learn how it was that the Mountain Water Chute in the Amusement Park did not commence functioning until well on in July. From a revenue-earning standpoint this failure to make good until the exhibition was half over meant a serious financial loss, and it was fairly obvious that someone had blundered. We are indebted to the *Engineering Gazette*, the house organ of Messrs. Marryat and Place and Marryat and Scott, Ltd., for some interesting facts relating to this matter.

It appears that, following the completion of the artificial mountain and lake, and the chute, difficulties arose over the elevation of the boats to the summit of the incline preparatory to making the plunge which so thrilled the participants in this attraction. The assistance of Messrs. Marryat and Scott was sought on July 2, and after due consideration of the requirements they undertook to provide appropriate lifts to raise the loaded boats to the required level within a month. As an incentive to speeding-up, a bonus to the men employed on the job, at the rate of £25 per day saved on contract time of three weeks for the first lift and five weeks for the second, was agreed upon and the order placed. Following hectic days of concentrated brain and physical labour, the first lift was completed and handed over in *eighteen days* and the second in *twenty-seven days*, a tribute to the capacity of the firm for dealing with emergency contracts despite all difficulties. The loss of revenue due to the failure of the original contractor to provide lifts is estimated at £15,000, and it is noteworthy that 294,201 passengers were carried on the two Marryat Scott lifts from July 23 to October 30.

Long-Life Electrics.

It is not generally realised that the wear and tear of electric vehicles in service is far less than in the case of the equivalent petrol or steam vehicles used for commercial purposes. This is a factor which should be taken into account when weighing the respective claims of the three types for a given service. According to figures quoted by a prominent official of an exceptionally large transport organisation in the United States, who have employed a very large number of electrically propelled vehicles for many years past, his company has found the electric capable of standing up in service for many years, and there are still in operation some of the vehicles which were purchased as early as 1907. With the modern improvements in design and manufacture of commercial electrics, it is estimated that they should be operated economically for a period of at least twenty years.

Prolonged Storage.

Apropos of my remarks recently on the long storage without leakage characteristics of the nickel-iron type of storage battery, a letter from an esteemed correspondent puts forward equivalent claims for batteries of the lead-acid type equipped with Lithanode plates. I understand that these batteries are equipped with specially cast plates enclosing the active material, which is very hard and keyed into position by shrinkage of the lead frames on to V-shaped projections on the edges of the blocks of active material. It may be that this type of cell has peculiar advantages in the matter of charge retention by comparison with other batteries of the lead-acid type, and I should be very interested in making comparative tests of the two types. It seems to me, however, that the whole problem resolves itself into the question of electrochemical characteristics and relative insulations of the two distinct types. Any battery which possesses an acid electrolyte is obviously more subject to local action than one in which the electrolyte is alkaline and comparatively inert, like potash. Moreover, liquids have a tendency to "creep," and an acid film is essentially a better conductor of electricity than an alkaline one. I am nevertheless open to conviction regarding the relative retention characteristics of the two types referred to.

Improved Dock Facilities.

In a paper read before the Institute of Transport on Monday last by Sir Alfred Read, attention is drawn to the disabilities in regard to docking and handling of cargoes under which the smaller coasting steamers engaged in home trade carry on their business to-day, and a strong appeal was made for better and more up-to-date facilities which would expedite loading and unloading cargo and enable these smaller vessels to make the best use of their time and tides. According to Sir Alfred Read, shipping accommodation at most of the ports is of the very poorest description, consisting of single-storied wooden erections—relics of the past. The requirements of to-day are double-storied sheds with raised platforms to facilitate loading and unloading of vehicles, chutes, and all other mechanical devices for the economic handling of traffic. In this connection there would appear to be an immediate field for the general application of electrically driven cranes, elevators, conveyors and similar gear for the rapid handling of cargoes, of which the manufacturers of such plant should not be slow to take advantage.

Developments in Illuminating Engineering.

The opening meeting of the Illuminating Engineering Society on November 18, as usual, provided evidence of its "live" condition. There were some interesting exhibits, and the report presented by Mr. Gaster this year revealed remarkable activity during the vacation. I am glad to see that this country is taking its share in these important international conferences. We must not forget that illuminating engineering is now developing rapidly in most of the chief countries, and it is a good thing that there should be regular intercourse between experts here and abroad.

Propaganda Work.

Another feature of the meeting was the wide range of subjects dealt with in a small compass. I was interested to observe a lady giving her experience of theatre lighting on the Continent. Both Mr. Gaster's address and the Report of the Committee on Progress in Electric Lamps and Lighting Appliances referred to various aspects of propaganda work. There is a general consensus of opinion that this form of work, while capable of being undertaken by many different bodies, should be correlated by the Illuminating Engineering Society so as to avoid overlapping of effort, and I hope that the Society will receive every support for their rapidly extending activities.

ELEKTRON.

ELECTRIC PASSENGER LIFTS.*

By H. MARRYAT (Member).

(Continued from page 655.)

Although there is no official supervision of electric passenger lift installations in this country, the percentage of accidents is extremely small and apparently rapidly decreasing, a fact reflecting high credit on the firms responsible for their design.

I have endeavoured to obtain some exact information as to the percentage of accidents, but without success.

The insurance companies have been unable to give me any figures, and the Home Office Reports deal with factory and workshop hoists only. I have had a search made of a large number of newspapers over a long period of years, and a précis taken of all the lift accidents reported, but a study of these has proved useless, inasmuch as it is usually impossible to discover from the newspaper report what type of lift is referred to, what is the cause of the failure or exactly how the accident occurred.

One is thrown back, therefore, upon one's own experienace, and mine is that the majority of accidents have resulted from one or other of the following conditions :—

(1) Absence of gate and interlock contacts on the car.

---

* Paper read before the I.E.E.

(2) Failure of gate-locks.

(3) Insufficient enclosure.

It is dangerous to permit a passenger lift to operate without a gate and interlock upon the car. Without interlocking contacts the attendant will insist upon starting the lift, and possibly closing the landing gate after the lift has started, before closing the car gate, and quite likely the car gate will never be closed at all. It must be remembered that a certain running clearance between the moving car and the face of the lift well is necessary, and, however smooth the face of the well may be with this running clearance reduced to a minimum it is always possible for part of the clothing or the foot or hand of a passenger to become jammed between the face of the well and the moving car.

The failure of gate-locking devices, in which I include the electrical interlock which prevents the lift from operating whilst a gate is open, has been responsible for a large percentage of accidents. If the lock is out of order it may be possible to open the landing gate and to step into the lift shaft in the belief that one is stepping into the car, or on an automatic lift it may be possible for the lift to be moved, by someone operating from some other floor, whilst a passenger is stepping into or out of the car. The remedy is the improved design and construction of the door-locking device, to which I will refer later, but a most valuable contribution to the safety of passenger lifts is to be found in efficient lighting. Too often the lift is stowed away in a dark corner. There should always be ample natural or artificial light immediately facing the lift entrance, and the car itself should be illuminated.

It is very difficult to persuade architects, builders or property owners of the necessity of carrying the enclosure above 6 ft. 6 in. in height in stair wells and other open places. A lift enclosure should be what its name implies and not, as many architects seem to think, a means of expressing their architectural ambition in iron and bronze. An enclosure which will allow an arm or leg to be thrust between the bars or below the bottom rail is dangerous, and there are hundreds of such enclosures in London. Cleaners and others will reach through on some pretext or other. The triangular space above each stair tread is a particularly dangerous point and should always be filled in. Apart from the danger to cleaners who thrust their arms and brooms through, articles—bottles sometimes—dropped on the stairway roll through here, and I have known a heavy bottle to smash through the top of the car. Dirt and rubbish is swept from the stairs through these convenient openings; this litters the top of the car and attaches itself to the greasy guides.

Upon the counterweight side, at least, the enclosure should extend from the floor to the ceiling, the reason being the large percentage of accidents which have occurred to cleaners, painters and others reaching over the enclosure for one reason or another, and, whilst observing the lift car, failing to notice the descending counterweight.

It is often desirable to fit a wire screen in the well at the point where the car passes the counterweight, for the protection of men who may be working on the top of the car—always an occupation of considerable danger. For the same reason a screen should be fixed in the pit so as to protect any person engaged in cleaning out the pit, from injury by the balance weight.

Collapsible gates should be constructed on the "mid-bar" principle, so that the space between the bars is insufficient to tempt any person to try to put his hand through for any purpose whatever.

I have briefly referred to what I believe to be the three principal causes of accidents in connection with electric passenger lifts. I shall now endeavour to review the subject more closely by suggesting the various possible types of accident and the preventive measures to be taken in each instance.

The moving car or counterweight may come into collision with some dislodged portion of the lift enclosure or with some article projecting into the lift well.

Counter provision.—The enclosure must be sufficiently substantial to prevent this possibility and there must be no opening or ledge upon which it is possible to rest any article with which the car or counterweight may come into contact.

The car coming into collision with the permanent stop at the top or bottom of the well, owing to the attendant omitting to operate the control circuit.

Counter provision.—Limit switches fixed in the well and operated by a ramp on the car and so connected as to open the control and brake circuit.

The car coming into collision with the permanent stop at the top or bottom of the well owing to some failure of the electric circuit rendering the control and the control limit-switches ineffective.

Counter provision.—Main limit-switches operated by a ramp on the car and so fixed and connected as to cut off the main electricity supply at both poles upon the car passing a certain distance beyond the top or bottom floor. It will be noted that the brake, being normally in the "on" position and held when the car is running only by means of an electric solenoid, must come into action when the main circuit is opened.

The car colliding with the permanent stops at the foot of the well due to excessive speed, the result of failure of the motor field circuit.

Counter provision.—A centrifugal governor gear operated by a chord attached to the car and so designed that a fixed excess of speed in the downward direction causes the main supply circuit to be opened and a safety gear attached to the car sling to come into operation. The function of this gear is to stop and support the car by means of grips pressed and wedged on the guides or guide backings.

The car coming into collision with the girders at the head of the well, due to a similar cause.—This cannot occur if the traction drive is employed and the counterweight allowed to land before the car reaches the permanent stops. Shock due to the counterweight landing at high speed may be minimised by the use of suitable buffers. In the case of drum-winding machines the only safeguard against this class of accident usually employed is the limit-switch and extra clearance for over-run of the car.

The centrifugal governor as usually employed is operative only in the downward direction of travel, but it can be designed to arrest the motion of the car in case of excessive speed in either direction.

(To be continued.)

Practical Electrical Engineering Hints.

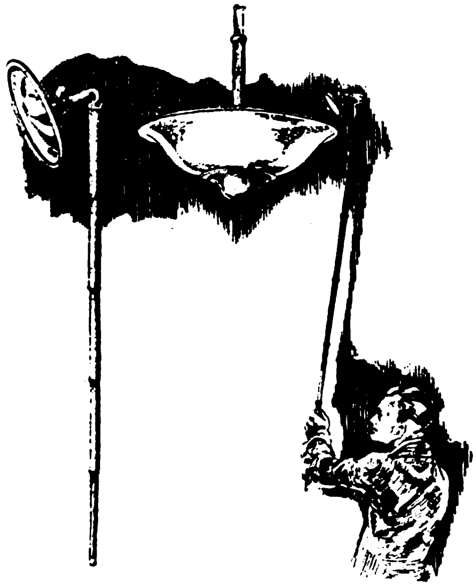
We cordially invite all our readers to contribute to this interesting and useful feature. All hints received will be given careful consideration and will be paid for at our usual rates.—THE EDITOR.

No. 23.—HOW A MIRROR FOR INSPECTING THE INSIDE OF INDIRECT LIGHTING UNITS WAS MADE.

It is well known that inverted bowls are excellent dust collectors, and the extent of the collection is not easily determined without considerable trouble; that is, under ordinary conditions it necessitates mounting steps and risk of breaking the glass-ware.

To enable the dust to be easily seen on the interior of inverted bowls I rigged up the device shown in the illustration. It consists of a convex mirror such as is used on motor-car wind screens, arranged to be held above the fixture by means of a telescopic tube; this may be made from the leg of a camera stand.

Experience with this device has proved its worth in a maintenance campaign recently carried out in our drawing offices, where a large number of inverted fittings are installed. As soon as dust is detected the glass bowl is changed for a clean one, and so efficiency of the lighting installation is maintained at its highest.—J. C. STAIR.



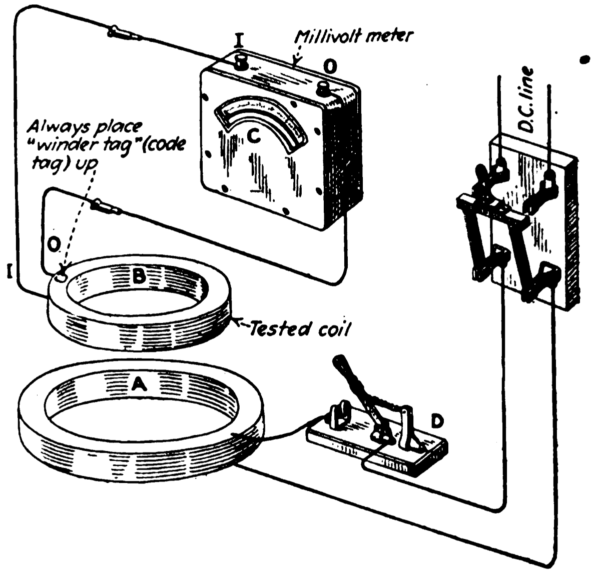
No. 24.—HOW COILS CAN BE EASILY TESTED FOR POLARITY.

When a standard method is used in a repair shop it is desirable to check the polarity of all coils before they are fixed into their respective pieces of electrical machinery.

This is necessary especially where such polarity cannot be determined by a mere inspection of the windings, such as in taped motor field coils, etc.

In the check used by the writer shown in the sketch, the coil *A* is permanently connected to a direct current system, so that direct current can be set up in it and broken at will; this is made possible by operating the switch *D*.

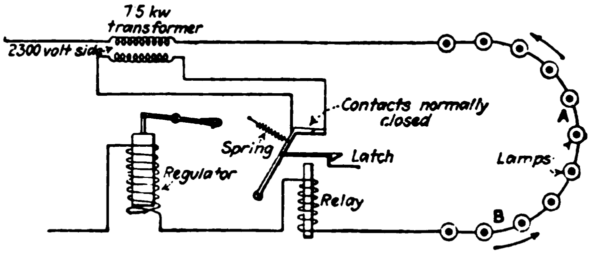
Coil *B*, the coil to be tested, is placed over this coil and the current set up by closing the switch *D*. When the latter is opened quickly the meter *C* gives a decided *kick*, the direction of which will determine the polarity of the coil *B*. Markings on the leads *O* and *I* can be checked at once to see whether they correspond with the polarity as determined by the test.



The coil *A* must be wound according to the supply voltage, since the resistance of the coil should be such that no heating is detected even when the coil is in circuit for some time. About 3,000 turns of 26 double cotton-covered wire will be found to be suitable for a 240-volt circuit.—F. W. GAY.

No. 25.—HOW LAMP BURN-OUTS WERE PREVENTED BY A RELAY SCHEME.

An installation which has saved a large number of high-power incandescent lamps has successfully been in use in a shipyard. The arrangement is that the 2,300 volt side of the transformer is connected in series with the lamps, with the low side open, when the current becomes excessive. The necessity for this installation was brought about by the burning-out of the series lamps on one of the circuits controlled from a sub-station. The equipment in the latter includes a regulator and switchboard, as shown in the sketch.



On one occasion a short circuit with the secondary of a lighting transformer occurred at the point *A*, and every lamp on the circuit from *A* back to the sub-station in the direction of the arrow was burned out. On another occasion a short circuit at *B* ended with the same result; this time, however, all the lamps from *B* back to the sub-station in the direction of the arrow were burned out.

An analysis of the conditions showed that if this trouble was to be avoided in future it was necessary to arrange to insert some high reactance in the line at the station in case of a short circuit or earth, the arrangement being that under normal conditions the reactance would be cut out.

It was decided to use as this reactance a 7½ kw. transformer rated at 2,300 volts primary and 350 volts secondary. Recognising the fact that the reactance of the primary of a transformer is high with the secondary open and low with it closed, the transformer was installed with the primary in series with the lamps, with the secondary connected to special relay contacts.

The relay consists of a pull-up coil connected directly in the line. Under normal current the armature of the pull-up coil floats within the coil, but with a sudden increase of current this armature is quickly pulled up and trips a latch which holds the contact points together, thus allowing the latter to be separated by the action of a spring. This inserts the high reactance of the primary in the line, and so the current is reduced to a small quantity.—E. B. JONES.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 193.

I wish to electrify a half-ton hand winch. This is used to lift wood to a height, through a derrick, of 45 ft. I would appreciate full details as to how the electrification can be carried out. The power supply available is 440 volt three wire.—"A. BAKER," Croydon

QUESTION NO. 194.

Can any reader tell me how I can best make micanite paper for insulating armature coils for 600 volt traction botors?—"E. A. B.," Wimbledon.

(Replies to Questions Nos. 193 *and* 194 *must be received not later than December* 27, 1924.*)*

Answers to Questions.

REPLIES TO QUESTION NO. 185.

The replies received were not satisfactory, so no award was made. —EDITOR.

QUESTION NO. 186.

When viewing a cinematograph picture, the wheels of a carriage appeared to be turning backwards. Can any reader explain this to me?—"INQUISITIVE."

REPLIES TO QUESTION NO. 186.

The first prize (10s.) has been awarded to "G. E. M." for the following reply:—

The so-called "moving pictures" which we see in a kinema theatre are nothing more or less than an illusion. There is no actual motion on the screen at all, and our eyes only interpret what appears there into animate events merely by virtue of a kind of defect. "Inquisitive" shows himself a trifle dubious of the illusion, because he says that the wheels of a carriage *appeared* to be turning backwards. Neither the wheels of the carriage nor the carriage itself moved in any way. A brief description of the illusion will serve to show how kinematography is possible, and how the odd effect noticed by "Inquisitive" and many others can take place.

I have mentioned that the human eye suffers from a kind of defect—I suppose it *is* a defect, though it has given us the wonderful science and art of kinematography. The eye does not happen to be quite the alert and responsive organ one imagines it to be. If the retina (or screen) of the eye receives an impression, a picture, it retains the same for a perceptible time after the cause has gone. It is this *persistence* which makes the "movies" (and other kindred effects) possible. For in kinematography all that the special camera does is to take a large number of *snapshots*, one after the other, of a moving object. At least about sixteen per second are necessary, and in practice that is about the rate adopted; for, having attained the desired illusion, increasing the rate would simply mean an uneconomical use of film. The kinema camera, then, takes a large number of snapshots, each showing a successive stage in the movement of the object being photographed.

Well, the series of snapshots—any one of which, for all practical purposes, might have been taken by your Brownie—is projected by a special kind of magic lantern upon a screen. After the first picture has been thrown on the screen the light is shut off, and the next snapshot is pulled into place; the light is again turned on and the second picture projected; off goes the light once more to allow number three to come into place; and so on with the rest of the film. This sequence of operations must be carried through rapidly enough to allow the pictures to be thrown on the screen at the same rate at which they were taken. Now, mark this: *Whilst the screen is darkened and another picture is being pulled into place ready for projection, the spectator's eyes can still see the previous picture, and when the next one is flashed on the screen the image of the previous picture merges into that of the next one.* So, owing to the sluggishness of the human eye and to the persistence of vision, the dark periods are not noticed at all, and those rapidly projected snapshots unite into what appears to be a moving picture.

Now, let us see what we can make of the curious carriage-wheel effect. This introduces an incidental sort of illusion; in a sense, the eye is being tricked twice. It is due to the fact that a carriage wheel consists of a number of *similar* spokes rotating around a common point. For our purpose it will be better at first to make that carriage wheel have but one spoke;

our minds can withstand the stress for a time, if the carriage cannot. Here is the wheel itself in Fig. 1, the one spoke standing up to its job in very courageous fashion. The carriage and the scenery must be imagined.

If the wheel happens to be turning round sixteen times per second, and the kinematograph camera takes sixteen snapshots of it, each picture would show the wheel just as we have it here. And when those pictures are thrown on the screen the spectator won't see any movement, or apparent movement, at all. But suppose the wheel does not rotate quite so fast as that. When the second snapshot is taken the spoke will not have gone right round, but will have only reached position (*a*), Fig. 2. Next snapshot it will be more out of place still—at (*b*). And so on. The result to the spectator watching those pictures on the screen will be as though the wheel rotated *backwards*.

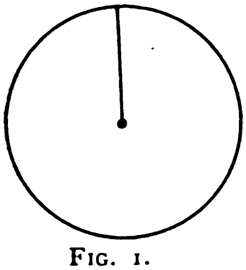


Fig. 1.

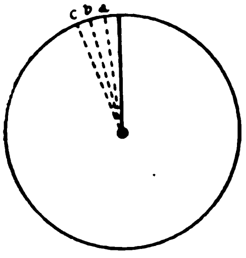


Fig. 2.

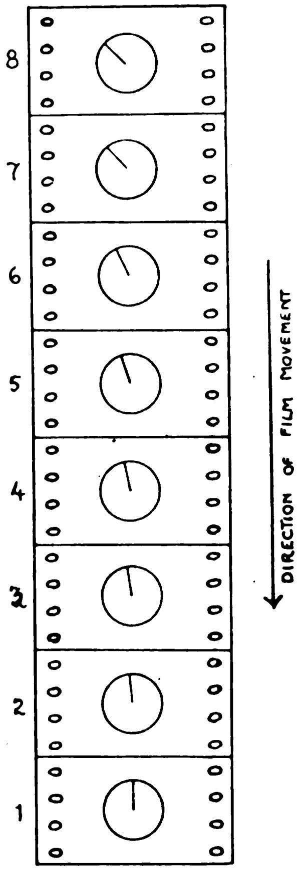


Fig. 3.

"Inquisitive" may wonder whether the converse effect is possible. It is. Let the wheel revolve at a slightly faster rate and it will appear to move *very slowly* in the correct clockwise direction.

Fig. 3 is an attempt roughly to show what such series of snapshots would be like on the actual film. The wheel is supposed to be moving clockwise, but not managing completely to rotate before next being "snapped"—this giving the backward effect when viewed on projection.

In reality, the wheel does not rotate as rapidly as we supposed. On the other hand, it has a large number of spokes, and a little thought will show that the apparent backward movement can still be given under certain conditions—owing to the fact that all the spokes are *similar in appearance*. It no longer is necessary for a complete, or nearly complete, rotation to be passed through before stationary or "slipping" effects can be obtained; *the distance between one spoke and another* is now the critical factor.

"Inquisitive" should refer to the May 23 issue of this paper. On page 274 he will find a kindred effect in kinematograph work dealt with.—"G. E. M."

No second award is made.

JUNIOR INSTITUTION OF ENGINEERS.

An exhibition of scientific instruments and apparatus arranged by this enterprising Institution was held at 39, Victoria Street on November 28. All the instruments exhibited were of special interest, due to the fact that they contained new and original ideas or that they contained improvements on old principles. Different forms of stress indicators were shown, chiefly of a type suitable for testing materials in completed structures as well as for testing specimens of the material in the laboratory. A stress indicator similar to that used in the tests recently conducted on Westminster Bridge was on view. Amongst a number of engine indicators was a Farnboro electric indicator for use on engines running at very high speeds. In this the pressure in the engine cylinder is opposed in a valve chamber by compressed air, a reading being recorded electrically when the pressure in the cylinder just balances the pressure of the air and causes a valve to move off one seat on to another. The air pressure is not varying rapidly and can therefore be ascertained. The record is made at the moment of equilibrium on a drum which moves in synchronism with the engine piston. Another interesting exhibit was an optical pyrometer which reads the temperature of metals in a furnace by matching the colour of the hot metal with a glowing filament in a lamp. The brightness of the filament is regulated by a rheostat, and is registered on the scale of a milliameter which is calibrated to show degrees of temperature. A mercury vapour lamp of the atmospheric type with a quartz body was shown in operation. It was said that the use of quartz instead of glass enabled the ultra-violet rays to pass and make the lamp especially suitable for therapeutic and bacteriological work. There was also a portable CO_2 recorder of metal construction with dry absorbents, making it particularly useful and handy for general work. Some of the latest designs of levels, theodolites and tachometers were shown and explained by means of diagrams and demonstrations.

Montevideo.—The State Electric Works, Montevideo, invite tenders for four air compressors. Particulars from the D.O.T., 35, Old Queen St., S.W.1.

Diaries, Calendars, etc.—We again have to thank Messrs. McCaw, Stevenson and Orr, Ltd., of Belfast, for a parcel of specimens of the Marcus Ward calendars for 1925. As usual, they represent the latest and most attractive types of wall calendars, etc., and the high standard of the past has been maintained both in quality of design and in excellence of workmanship. The pictures are by artists of high repute, and show a great variety in subject and treatment. Readers need only study the window of any enterprising stationer in order to see them for themselves, and make their choice without any difficulty.

KNARESBOROUGH ELECTRICITY UNDERTAKING.

By the turning of a switch in the Knaresborough Town Hall one day last week the Knaresborough electricity undertaking was officially opened.

The ceremony was performed by Mr. B. Brown, chairman of the Gas and Electricity Committee of the Urban District Council, who recalled that it was just a hundred years since the first gas lamps were lighted in the town. At that time the chairman of the local authority, then known as the Improvement Commissioners, was Mr. Robert Gott, and another Mr. Robert Gott, grandson of the former, took part in the new ceremony. It is nearly twenty years since the provision of electricity for Knaresborough was considered, and later two schemes were prepared with the purpose of using local water power. They were dropped on account of the heavy capital expenditure that would have been required. The scheme now in operation is the purchase of electricty supply in bulk from the Harrogate Corporation and its distribution by the Knaresborough Council.

The present scheme at Knaresborough has been carried out to the specification of Mr. George Wilkinson, M.I.E.E., of the Harrogate Corporation, and comprises alternating current, single-phase installation taking supply at 2,000 volts and distributing at 200 volts. The whole of the scheme has been carried out by the Western Electric Co., Ltd., of North Woolwich, who have sub-let switchboards transformers and kiosks to the contractors specified.

The main switchboard is an eight-panel truck type board manufactured and erected by the Park Royal Engineering Co., Ltd., which, having two feeder panels for the cables from Harrogate, distributes high-tension feeders to six transformer kiosks in various parts of the town.

The laying of cables, supply and erection of switchboards, transformers and kiosks, for which tenders were invited as recently as May last, are now practically completed and the contractors were congratulated on the expeditious manner in which the work has been carried out, the cost of the scheme being between £7,000 and £10,000.

Reviews of Books, &c.

[*Books noticed in this column will be sent from* Electricity *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.*]

As Men Sow. By Robert Brymer. (Foulis, 7s. 6d. net.)—The author of this novel is well known in the electrical trade, and is associated with Messrs. Siemens and English Electric Lamp Co., Ltd. The story, which is well thought out, holds the interest of the reader from beginning to end, and in it one gets a glimpse of the activities of commercial life, the chief lesson taught being that "It is not so much the price you pay for the goods you get that counts, it's the goods you get for the price you pay."

Mr. Brymer has our hearty congratulations and best wishes for his future success in the literary sphere, which, we understand, he has taken up in the nature of a hobby and does not in any way affect his connection with the electrical business.

The Empire Municipal Directory and Year Book, 1924-25. 336 pp. + Diary. (Municipal Engineering, 8, Breams Buildings, E.C.4, 11s. post free.)—We have pleasure in directing the attention of our readers to the new edition of this well known Year Book, now in its 42nd year of publication. Not only may it be claimed that this constitutes an encyclopædia on all aspects of muncipal work—the special articles being written by acknowledged authorities—but also this is the only publication which contains complete and officially corrected lists of all the corporations, county, urban and rural district councils in Great Britain and Ireland and our Overseas Dominions, and their chief officials. The compilation of a return of the chief officials of the most important cities in the world is a task which has not previously been attempted, and the inclusion of this information is one of the outstanding new features of the present volume. As in previous editions, the special articles constitute a review of progress during the past year and a record of present practice on all branches of municipal engineering. How wide is the scope thus covered can only be realised by those who are engaged in this most important branch of public work. To all of our readers who are interested in any way in municipal activities, or who wish to establish business relations with public authorities, we commend most heartily this *vade mecum.*

The M.G.C. Manchester Year Book, 1924. 172 pp., with map. (*Manchester Guardian*, Manchester, 2s. 6d. net.)—In preparing this, the fourth issue of the M.G.C. Year Book, practically the whole of the work has been rewritten, and some entirely new features have been introduced, especially in the textile section. In its new form, the Year Book presents as nearly as possible a complete and accurate guide to the trade and industry of Manchester and the whole of the busy area of South East Lancashire, which Manchester serves. As a work of reference concerning the multifarious activities of the city, and concerning its leading personalities, the Year Book cannot be too highly commended. As a possible improvement, we suggest the inclusion of the equivalents in foreign languages of trade terms in the textile and allied industries.

Third Annual Report of the Electricity Commissioners, 1922-23. 142 pp., illustrated. (H.M. Stationery Office, 2s. 6d. net.)—The principal features of the period covered by this report were:—(1) The general improvement in the position, and the rising curve of output of the supply undertakings in Great Britain as a whole and (2) the enactment of the Electricity (Supply) Act, 1922. Decreasing costs had the doubly satisfactory result of increasing the demand for electricity and lowering the cost of production. The Report takes note of the important part played by increases in domestic load and emphasises the fact that many undertakings are making special efforts further to increase such loads. Naturally this, as well as the industrial power load, is a matter which concerns the majority of our readers, whether as contractors, dealers, supply station employees, wiremen or consumers. Benefit to one class of the electrical community will inevitably bring benefit to all, and we find in this Report good grounds for optimism. Apart from its value as a record of progress achieved, and as a review of the general position of electricity supply, the Report records the work accomplished by the Commissioners in the reorganisation of electricity supply, and gives particulars of new schemes, extensions and modifications. The Report thus contains much matter of general interest and is indispensable as a work of reference. It is announced in the prefatory notes that the Commissioners will shortly be issuing a complete list of all authorised undertakers in Great Britain, and, possibly, another list of non-statutory and private undertakings. These will be welcome additions to the records already available.

Various Items.

Personal.—Mr. F. S. Hooker has relinquished his position with the Sterling Telephone and Electric Co., Ltd., with whom he has been associated for the past 23 years, and joined the board of C. A. Vandervell and Co, Ltd., in the management of which he will take an active part.

New Book.—T. Werner Laurie, Ltd., are just publishing *Steamship Models*, by E. Keble Chatterton. It shows pictorially the wonderful evolution of the steamship from the days of the wooden sailing ship to the present epoch of mammoth liners and battleships, and contains 128 plates in colour and half-tone. The edition is limited to 1,000 copies. The price will be £3 3s. net.

An Invitation Accepted.—The Main Committee of the British Engineering Standards Association have recently authorised the Secretary (Mr. le Maistre) to accept the cordial invitation of the German Standards Committee (the N.D.I.) to be present at their annual meeting on December 13. He is also going to Prague to give an address on "Industrial Standardisation" before the recently formed Czecho-Slovakian Standards Committee.

Personal.—Mr. W. E. Warrilow has sold his partnership interest, as from August 31, 1924, in Lionel Robinson and Co., to Mr. Lionel Robinson, who will continue the business of general and wireless engineers and merchants at 3, Staple Inn, London, W.C.1. Mr. Warrilow has decided again to take up engineering advertising and technical journalistic work. His address for the time being will remain at 40, Mildred Avenue, Watford, Herts.

Kingstown (Co. Dublin).—At the meeting of the Urban Council on the 18th ult., the Chairman said that the Council had entered petitions against the Electricity Bills before the Dail, in order to secure the rights of the Council under its own scheme, and to try to secure it against the granting to any of the bodies promoting Bills of rights averse to the local interests. It had also arranged with Blackrock to be represented by the same counsel in order to reduce the costs.

The Engineers' Club.—The following meetings of interest to many of our readers will be held at the club during December—viz.: 6th, Chief Technical Assistants' Association; 9th, Associated Municipal Electrical Engineers; 9th, Mining and Electrical Engineers; 10th, Institute of Motor Traders; 11th, Institute of Patentees; 13th, third annual dinner, N'ions; 18th, Institution of Mining and Metallurgy Council Club dinner; 18th, Institution of Locomotive Engineers; 19th, Associated Municipal Electrical Engineers.

The Metric System.—The annual meeting of the Decimal Association presided over by Sir Richard Gregory was held recently. In his address, the President called attention to the spread of the metric system throughout the world, the latest adherents being Japan, Siam and Rusia. Reports from these countries show that the change is making rapid progress. Sir Richard Gregory further pointed out that any nation which had altered their weights and measures had always chosen the metric system, in spite of the preponderance of British trade. New Vice-Presidents are Sir Hedley le Bas and Messrs. Llewellyn Atkinson, Harold Cox and Gordon Selfridge.

Meetings.—The Junior Inst of Engineers will meet on Friday, 5th inst. Lecturette, "Metal-cutting Under Water by the Oxy-acetylene Blowpipe," by J. B. Polland (slides and demonstrations). Also on Friday, 12th inst., paper, "Fluid Transmission Gears," by H. G. Bouly (slides), and on Friday, 10th inst., lecture, "Aircraft in Japan, preceded by a few experiences of the King's Cup race, 1924," by Col. the Master of Sempill (Member), slides. All at 39, Victoria St., at 7.30 p.m.

Germany.—Shortly about 100 items will be removed from the import prohibition list, including driving belts, platinum, nickel wire and electric arc lamps.

The Batti-Wallahs.—This Society holds a luncheon at the Hotel Cecil on Wednesday, December 10, at 1 p.m. sharp. Chief guest, Vice-Adm. Sir R. B. Dixon, Director of Engineering Admiralty

Tenders Accepted.—The General Electric Co. have recently booked orders for 100,000 Osram lamps out of 111,250 lamps for the Sydney Municipal Council; 17,500 gasfilled lamps for the Bombay, Baroda and Central India Ry.; and for 8,000 lamps for the East Indian Ry.

Meetings.—The Inst. of Engineers-in Charge will meet at St. Bride Institute, Bride Lane, Fleet St., E.C.4, on Wednesday, Dec. 10, at 7.30 p.m., when the President-elect, Mr. T. Cooper, M.A., M.Inst.C.E., M.I.Mech.E., M.I.E.E., will deliver his second address to the members. The subject will be: "Responsibilities and Training of the Engineer-in-Charge."

P.O. Technical Instructions.—Every telegraph reader both here and in the Colonies will be interested in the new publication, entitled the *Wheatstone Telegraph System*, which has just been issued by the Post Office Engineering Dept., being *Technical Instructions V.*, and a review of it will appear in these columns at an early date. It has 55 foolscap pages of text and 30 pages of diagrams, and copies may be obtained from S. Rentell and Co., Ltd., 36, Maiden Lane, London, W.C.2, for 3s. 11d. post free.

Trade Notes.

Publication No. 1004 has been received from the **Brush Electrical Eng. Co., Ltd.**, of Falcon Works, Loughborough. It contains a well-illustrated article on an installation of the Brush-Ljungström Turbo Generator at a cement works on the Bristol Channel, including an excellent description of the actual construction of the turbo sets as well as of the plant generally. It should therefore be of interest to consulting engineers and power plant contractors, not only in Great Britain, but also in the Colonies and foreign countries which are likely to require plant of this description in order to develop their local industry, and it is to be hoped that the enterprise of the company in preparing such a reprint will be rewarded in the way of additional contracts from all parts of the world.

New publications, Nos. 504, "Country House Lighting," 507, "Old Time on a New Task," and 515, "'Dog' Folder. Chilly Days." have just been issued by the **Electrical Development Association**, and may be obtained in quantities from the secretary at 15, Savoy Street, Strand, London, W.C.2. They are excellent adverts. from the point of view of assisting contractors and dealers in electrical supplies to attract clients, and for general use in their advertising campaigns, and it is, therefore, to be hoped that every endeavour will be made to take advantage of the exceptionally low price at which they can be purchased in quantities. The outlook for the electrical industry is undoubtedly brightening very rapidly indeed, and it behoves all dealers to take full advantage of the facilities which are offered so lavishly by the Association.

A very well illustrated souvenir has been issued by the **London Electric Wire and Smith's, Ltd.**, of Playhouse Yard, Golden Lane, London, E.C.1. As a matter of fact, it was used by the company for distribution at the British Empire Exhibition at Wembley, and is not only a souvenir of their exhibit, but also a brief résumé of the history of the two companies, which are now under the joint title, together with a splendid series of illustrations of the various sections of the works. It is, therefore, certain to prove of direct interest to the many clients of this very enterprising company, the manufacturers of which are becoming more and more widely known as the years roll on.

We have received from **Messrs. Engineering Supplies, Ltd.**, of 155a, Upper Thames Street, London, E.C.4, a sample length of 16 S.W.G. Square Tinned Copper Wire, insulated ready for use with sleeving. The sleeving is of woven cotton specially impregnated, and certainly makes a nice, clean-looking job. In order to bare the wire, the sleeving may be easily cut through and slipped off, without damage to the wire. It is supplied in 3 ft. lengths, made up in bundles of 100 lengths, and where an insulated wire is required it certainly appears to be a good proposition, and will no doubt save time, as it is not the easiest of jobs to fix insulated sleeving over square tinned copper wire. The appearance of a set neatly wired with this material should be extremely good.

A Popular Scientific Weekly Journal
ELECTRICITY
Practical Trade Journal

DECEMBER 12, 1924.

CONTENTS. PAGE

Northampton Polytechnic Institute Distribution of Prizes and Certificates 679
An Attractive Christmas Decoration 680
Progress in Wimbledon 680
A Novel Method of Starting Polyphase Synchronous Motors 680
Resistance Welding 682
Questions and Answers by Practical Men 682
Current Topics 685
Correspondence 687
Our Wireless Corner 687
The "Electrodome": A New Hair Drying Device 688
Electrical Engineering: Final Grade 689
Electric Passenger Lifts 690
Reviews of Books 691
Various Items 692

NORTHAMPTON POLYTECHNIC INSTITUTE DISTRIBUTION OF PRIZES AND CERTIFICATES.

Tributes to Dr. Walmsley.

On Friday evening last the annual distribution of prizes and certificates was made at the Northampton Polytechnic Institute, Clerkenwell. The prizes and certificates were presented by the Most Honourable the Marchioness of Northampton, and the Marquess of Northampton, D.S.O., was present and delivered an address. Mr. L. B. Sebastian (chairman of the governing body) presided. It will be remembered that, since the last annual meeting, Dr. R. Mullineux Walmsley has met his death, and most of the speakers of the evening made some allusion to the late principal.

The chairman said that Dr. Walmsley has been elected as from the 1st of January, 1896, and from that date until his lamented death had been the trusted adviser of the governing body and the guide of the Institute's educational and recreational activities. With his assistance the building had been developed so as to accommodate the needs of the members and students, the details of the scheme of education determined, and provision made for the social side, embracing the gymnasium, swimming bath, recreation ground and other facilities. It had been Dr. Walmsley's greatest delight to see the Institute developing, and he had never been satisfied to leave others to work out his plans. Everything had been done under his personal supervision, and no function had been complete without his presence, by which all were stimulated and inspired. (Applause.)

Speaking of the new principal (Mr. S. C. Laws, M.A., M.Sc.), the chairman said it was not easy to follow a man who had created everything, but the governing body had succeeded in finding an adequate and popular successor to their late friend and guide. Mr. Laws had now been in office for a couple of months, and every day that passed during his occupancy of that position tended further and further to convince not only the governing body, but all friends of the Polytechnic, that the choice had been a wise one. (Applause.)

Mr. Laws followed, saying that he had known his predecessor for some years, and had known him as one of the giants of the educational profession. Continuing, he gave some particulars of the past year's working and the present position of the Institute. He said there were now 789 members, as compared with 821 a year ago, and 2,063 students, as against 2,145. Some 81 persons had joined both as members and as students. Amongst the 2,063 students, 203 had attended the day college, the remainder being in attendance at part-time classes, of which the great majority were held in the evening. When due allowance was made for the fact that the day student was in attendance each week for a much longer period than the evening student, the educational facilities of the Institute were approximately evenly distributed between day and evening. It should be remembered that the two sets of student were distinct, but the two types of work were not intrinsically different. The important distinction was one of conditions. The day student was fortune's favourite, and undoubtedly gained more from the Institute. There was room for a steady flow both from the evening classes to the day course and from the day course to the evening classes. To two groups of persons he wished to offer a special word of thanks: one group consisted of the firms who joined the Institute in its educational work by accepting its day students during the summer term; the other group consisted of the donors of prizes. (Applause).

The Marquess of Northampton followed with an address urging the students not to look upon education mainly as a means of making money, but to aim at something higher. Besides specialising at their profession they should have intellectual hobbies. They should never regard their education as completed, but should search to know the truth in every subject. (Applause.)

The Marchioness of Northampton then distributed the prizes.

Mr. J. T. Wallis (Mayor of the Borough of Finsbury) proposed a vote of thanks to the Marquess and Marchioness, and this was seconded by Lieut.-Col. W. A. J. O'Meara (late chief engineer to the Post Office). The vote of thanks was heartily accorded and briefly responded to.

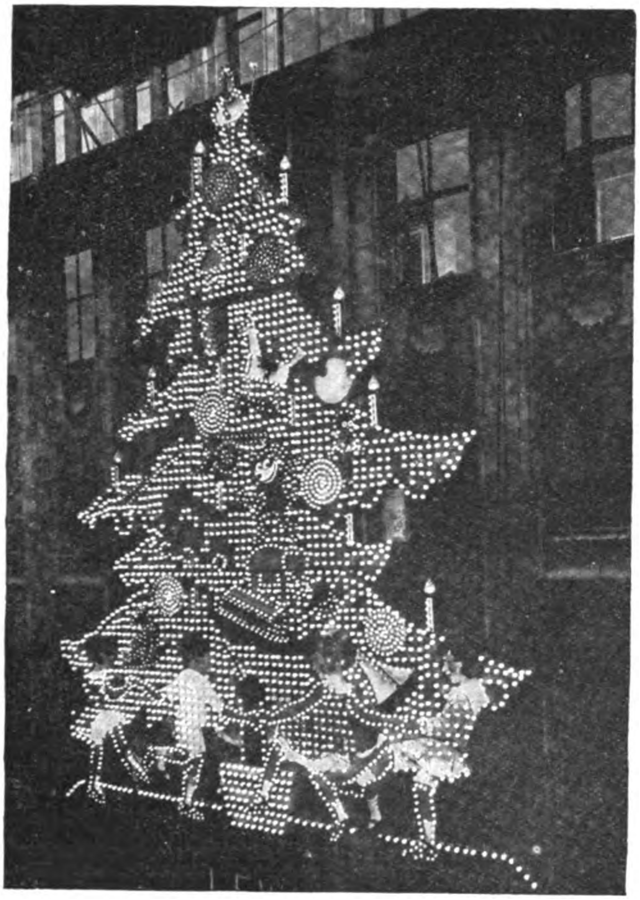
Mr. G. M. Gillett, M.P., moved a vote of thanks to the chairman. It was duly seconded and heartily accorded.

In replying to the vote of thanks, the chairman said thanks were also due to the staff, especially to Mr. William Keller Davis, who had been in charge during the period between the death of the late principal and the commencement of the term of office of the present one. (Applause.)

As on previous occasions, organ recitals were given in the course of the evening, and there was an exhibition of laboratories, workshops, etc., and a display in the gymnasium.

AN ATTRACTIVE CHRISTMAS DECORATION.

The annexed illustration, although absolutely accurate, conveys but an imperfect idea of the effect of the large sign erected outside Messrs. Lewis's Emporium at Manchester; it depicts children dancing round the Christmas-tree, and in it more than 3,000 Osram clear and colour-sprayed lamps are used.



PROGRESS IN WIMBLEDON.

Matters electrical in Wimbledon are in a most satisfactory state, as the report of the Electricity Committee, submitted at the last meeting of the Council (Wednesday, December 3), eloquently proved. New boiler plant is needed, and on the recommendation of the committee it was decided that application be made to the Electricity Commissioners for sanction to borrow £17,250, the estimated cost of providing same. Further, it was decided to borrow £3,250, the cost of installing economisers at the generating station, altering pipework, etc.

The report of the committee, which was adopted by the Council, also included a report on its inspection of the generating station and the chief engineer's report on the position of the undertaking, its working costs and development. The committee by resolution expressed to the chief engineer (Mr. A. E. MacKenzie, M.I.E.E., M.I.Mech.E.) "their appreciation of the efficient and able manner in which the station and undertaking generally is being conducted, and congratulates him upon the successful financial results which he has achieved." A further resolution thanked the chairman (Councillor Hickmott) for his unremitting attention to the undertaking, and the business aptitude he had shown in all matters affecting its welfare.

It may be added, as showing the growing popularity of electricity in this ancient Surrey borough, that the accounts for 1921 showed a less of £3,699. Mr. MacKenzie was appointed in June, 1922, and in that year a profit of £5,894 was returned. This creditable result was improved to £28,701 in 1923, and to over £30,000 in 1924. The consumer has benefited in that the cost per unit for lighting has been reduced from 8d. in 1921 to 4½d. in 1924, and cooking and heating from 2½d. to 1d.; while the financial position is now in such a strong state that, we understand, further reductions will be made in the coming year.

A NOVEL METHOD OF STARTING POLYPHASE SYNCHRONOUS MOTORS.*

By E. V. Clark, B.Sc., Associate Member.

(Paper first received November 19, 1923, and in final form March 31, 1924.)

(Continued from page 659.)

Various tests of the two varieties of this method of starting synchronous motors have been carried out in the electrical engineering laboratory of the University of Adelaide with the small plant already referred to. Of the two ways, viz., running up simultaneously with a squirrel-cage type asynchronous alternator, and starting on the rotor rheostat of a wound-rotor type asynchronous alternator, the latter is found to be appreciably the better with the laboratory plant. To run up simultaneously needs considerably greater care, as the D.C. motor starts up very rapidly on the first notch of its ordinary starting rheostat, and the synchronous motor must be given the hand start at just the right moment. On the other hand, if a special D.C. rheostat is used and the first notch allows but little current to flow, the sudden access of load as the asynchronous alternator picks up may cause a drop in speed sufficient to let the synchronous motor come to rest. With the wound-rotor type of asynchronous alternator, the easiest way to start is to run this up to speed, set the rotor rheostat on the first notch (or on that notch which gives maximum torque at the speed adopted), connect the stator to the unexcited synchronous motor, give a hand-turn and then close the field switch. The synchronous motor used in the experiments has very excessive "tooth-lock action," and it is impossible to give the shaft any considerable spin by hand if the field is excited. With a type of synchronous motor having more uniform flux distribution, it would be a matter for experiment to determine whether the final act should be to throw in the field switch or the main A.C. switch. Naturally, excessive power is needed for the hand-turn if the motor is both excited and connected to the alternator, as suggested in the preliminary description of the method.

Tests of starting up a synchronous motor under load were made by belting the motor to a line shaft and thence to a set of three unexcited 2½ kw. machines with six bearings and rigidly coupled shafts. It was found just possible to start up on this load, if care was taken that as the rotor rheostat was moved from notch to notch the line current was not allowed to exceed the normal current rating of the asynchronous alternator by more than 25 per cent. or so. If this were exceeded, the torque became too small and the synchronous motor came to rest. The motor was much under-excited, so that the stator flux would be considerably below normal.

---

* Paper read before the I.E.E.

To test this method of starting on a machine of greater magnitude, experiments were next made upon a rotary converter of 150 kw. capacity in one of the converter stations of the Adelaide tramways. This is a three-phase 25-cycle 500-r.p.m. machine; and for the asynchronous alternator set the battery booster of the station was adapted, consisting of a 40 h.p. induction motor with wound rotor, driving a 200-ampere 150-volt booster. Temporary leads from a 100-volt tapping on the battery were connected through a water-bucket starter to the booster, by means of which it was run as a D.C. motor; and the stator leads of the induction motor were removed from its transformers and connected to the A.C. terminals of the rotary converter, the field of which was separately excited. The induction motor is normally run off the transformers of one of the converters, so that its voltage was suitable. The experiments were quite successful, but it was found only just possible to give the converter the necessary hand-turn. The machine in question is provided with a belt-connected pony motor, by means of which it may be started from the A.C. side. With the belt removed, two men pushing on the pulley and armature barrel-end were not able to impart sufficient velocity to cause the machine to pick up. On replacing the belt, however, the greater facility thereby afforded for an effective hand-turn enabled the same two men to give the requisite start. No attempt was made to measure the required initial speed, but the author's impression is that it was in the neighbourhood of 30 r.p.m., or, say, somewhere between 5 and 10 per cent. of the rated synchronous speed in this case.

Starting up was tried both on the rotor rheostat, and simultaneously with the rotor short-circuited. The former method enabled the set to be readily run up to speed for synchronising on to the transfomers. The latter tests showed that the set could be started up about as easily on the alterative method; but the conditions were abnormal, the D.C. starting rheostat of the battery booster set being an improvised water bucket which facilitated the running of the set at low speed but did not give sufficient range of resistance to enable the set to be brought up to full speed under load.

In all these tests it was found desirable to excite the converter field before giving the hand-turn, and to let the closing of the main A.C. switch be the final action when a sufficient hand-turn had been given. The difficulty of turning the armature by hand was much the same, whether the field was excited or not, if the main switch was open; whereas the closing of the main switch made considerable difference, probably due to currents caused by residual magnetism. In this respect the behaviour of the rotary converter was just the reverse of that of the laboratory synchronous motor.

In both laboratory and converter station tests, one fact was as evident as it was unexpected, viz., that starting up was very much easier if the synchronous motor was much under-excited. One would anticipate just the opposite. A somewhat superficial explanation that suggests itself is as follows: At the moment at which the circuit becomes active, whether by closing the main switch or the field switch, it is the synchronous motor which delivers energy to the circuit; and not until the flux of the induction motor is built up does that machine act as an alternator and supply energy. Hence the stored energy of rotation imparted to the synchronous motor by the hand-turn must be sufficient to supply this initial flow of electrical energy without bringing the machine to rest. Now at a given speed the voltage is proportional to the flux, while the current will be almost proportional to the voltage. The time taken for the flux of the induction motor to build up will be much the same at any voltage, since the time-constant of the circuit is but little affected. Thus it follows that at a given speed the energy to be supplied by the synchronous motor will vary almost as the square of its flux. The value of field excitation to give the easiest starting—that is, the minimum hand start—will therefore be the smallest value sufficient to provide enough torque to keep the synchronous motor in rotation. It is very noticeable in the laboratory tests how, at a speed quite sufficient with low excitation, the motor comes to rest with a jerk on switching on too strong a field current.

It will be noted that the line current, which lags relatively to the voltage generated in the synchronous motor by a small angle at the initial moment, must swing round to a lag of about 130 deg. by the time the asynchronous alternator takes charge, since the latter can only deliver a leading current; and further, that as meanwhile the synchronous motor has given out energy and therefore dropped in speed, the frequency must fall steadily during this momentary transition period. A record by an oscillograph showing the waves of current and E.M.F. during the second or two following the closing of the circuit, would be of much interest and might render more evident the conditions required for the easiest starting up of a synchronous motor by this method.

(To be continued.)

"**The Motor Ship.**"—A special New Year number of the *Motor Ship* will be published on Jonuary 1. It will contain a full account of the 23,000-ton 18-knot motor passenger liner *Aorangi*, due to be completed this month, as well as much other information of direct interest to engineers who are in any way associated with motor ships as such, or with the electrical machinery which is installed thereon

An Active Industry.—According to the December issue of our esteemed contemporary, the *Motor Ship*, the tonnage of motor vessels built during 1924 is almost exactly twice the corresponding figure for 1923. The issue to which we refer also contains a large amount of information on the subject of Diesel engines and auxiliary electrical plant in use on various motor-driven vessels, which will appeal directly to a large number of our readers.

Dutch East Indies.—The report on the economic situation of the Netherlands East Indies has just been issued by the Board of Trade, and may be obtained from H.M. Stationery Office or *Electricity* office, price 2s. 8d. post free. It is pleasant to note that there is an improving demand for electrical machinery, and there are also particulars of the electrifications of certain railways as well as of hydro-electric stations which have been built or which it is thought advisable to construct in the near future.

RESISTANCE WELDING.*

By F. E. SAUNDERS, M.I.E.E.

Methods of electric welding may be divided into two classes: arc welding, in which the heat is obtained from a carbon or metallic arc; and resistance welding, in which a heavy current overcoming the contact resistance between the two surfaces raises the metals to the required temperature.

Arc welding suffers from several disadvantages. The efficiency of a D.C. motor generator, if used for this process, is rarely above 65 per cent.; whilst, if resistance control is used, still greater losses are occasioned. Using A.C., a choker can be used to control the voltage, but this entails the objection of a very low power factor. The efficiency of the transformer used for resistance welding is very high, and, moreover, the heat generated for this process is used much more advantageously than with the arc process.

Resistance welding comprises three processes: spot welding, seam welding and butt welding. The heavy current required is furnished by the secondary of a low-voltage transformer. As this secondary voltage is between 2 and 4 volts, exceptional care must be taken that all connections, other than the joint to be welded, are kept as low in resistance as possible.

For spot welding the water-cooled electrodes are fitted with points of a size appropriate to the capacity of the transformer and the material to be welded. Should the size be inaccurate, the heating spreads over too great an area, resulting in defective penetration. The electrodes are applied to the work, and some mechanical pressure is applied. Current is then switched on and further pressure applied till the plastic state is attained. The pressure is then still further increased, and before releasing, current is switched off. This latter sequence is ensured by automatic gear.

The welded spots are of the nature of rivets. Although watertight joints cannot be obtained by this process, by close spotting the seam is quite efficient for viscous liquids.

On machines for the continuous welding of seams the electrodes take the form of copper rollers, the top roller being rotated by suitable means, the bottom roller being free. The rollers exert the necessary mechanical pressure on the work. An average machine has rollers about 11 in. in diameter, of sufficient width to form a seam about one-quarter of an inch wide. No provision can be made in this process for cooling of the work before the pressure is released, but this is not found a defect.

Butt welding is used for joining ends or butts. These should be so faced that the heat is evenly distributed. If a dead flush is not obtained, the current is cut off one or more times to allow of regular distribution of heat before final pressure is applied. Neglect of this precaution leads to a non-homogeneous weld.

The possibility of failure just referred to has led to the development of the flash welding process. The feature of this process is the provision of means whereby the movement of the two ends of the work is made very slow. This slow movement allows the butts, which are generally out of truth, to be burnt to a true and square surface before actual contact. The rate of approach is ascertained visually by watching the sparks which are thrown out. Too rapid an approach stops the sparking, whilst too slow a movement causes intermittent sparking and insufficient heating. Immediately the faces are true, the butts are observed to be evenly heated all over. The advancing mechanism is then thrown out of gear and pressure applied in order to effect the weld. Unlike an ordinary butt weld, the "upset" produced is very small. This upset must in all cases be removed by grinding or cutting away, and never by hammering.

Spot welding is used for the manufacture of such sheet-iron articles as would require riveting or bolting, but, unlike these processes, causes no reduction in the strength of the metal. Unskilled labour can be employed, as all risks of failure can be eliminated by the provision of automatic gear.

The work of the seam welder is more or less limited to hollow-ware or sheet-iron articles, but in these industries an extensive range of work is covered. The butt welder is far more adaptable. For repetition work it supersedes the smith's forge, not merely on the score of cost, but also on that of reliability, as great uniformity in the class of work is easily obtained. The introduction of the flash method has effected considerable improvement on the older method, as uneven butts can be welded with practically no upset. Special butt welding machines have been developed for brass and copper, these metals requiring a more delicate mechanism for advancing the pieces and automatically cutting off the current at the correct moment.

---

[*] Abstract of paper read before the Institution of Welding Engineers.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.

ANSWERS: A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

QUESTION NO. 193.

I wish to electrify a half-ton hand winch. This is used to lift wood to a height, through a derrick, of 45 ft. I would appreciate full details as to how the electrification can be carried out. The power supply available is 440 volt three wire.—"A. BAKER," Croydon

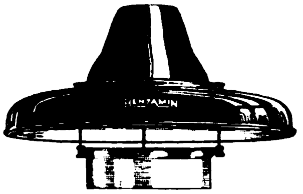
QUESTION NO. 194.

Can any reader tell me how I can best make micanite paper for insulating armature coils for 600 volt traction botors?—"E. A. B.," Wimbledon.

(Replies to Questions Nos. 193 and 194 must be received not later than December 27, 1924.)

Brilliant Light Without Glare

The BENJAMIN BIFLECTOR



The latest contribution to scientific illumination.

Ideal for Spinning Frames, Weaving Looms, Compositors' Frames, Offices, Schoolrooms, Hospitals, etc., etc.

Advt. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited, and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL & Co., LTD., 36–39 Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

Smoke Abatement—

Mr. Beauchamp, of the British Electrical Development Association, contributed some very interesting remarks to the conference on smoke abatement at Manchester. He pointed out, *inter alia*, that the Manchester Electricity Supply Department had put out of action in ten years some three hundred industrial chimney stacks, thereby reducing the smoke nuisance of that city to an appreciable extent. At the same time it must not be overlooked that the principal offender is still the domestic grate, and that the housing problem being still acute it is extremely unlikely that in our time, at all events, the existing domestic chimney will become a thing of the past. The only compromise we can hope to effect is to gain as many converts as possible to the all-electric idea as represented by the complete conversion of their domestic electric heating and cooking installations to electricity, or at all events a joint conversion involving gas and electricity plus slow combustion or modern smokeless ranges.

Doubtless there are thousands who appreciate to the fullest extent the manifold advantages of an all-electric service, and would be only too glad to remove their goods and chattels into houses equipped on this principle if only the houses were available. Meanwhile it is inspiriting to note the praiseworthy enterprise of certain authorities in making a commencement with the erection and equipment of these ideal homes. The latest example is that of the Woolwich Borough Council, who have equipped four houses on the Council's estate at Eltham in order to demonstrate the possibilities of electricity with regard to lighting and heating at a cost for electrical energy of about 7s. 7d. per week. In these houses there are no chimneys, and no chimney breasts (with the exception of one in the living-room) and the saving to the Council in brickwork, fireplaces, etc., is estimated to cover the cost of the electric equipment. In each house there are nine electric lighting points, with heating plugs in all bedrooms, the living-room, and parlour. In addition an electric fire, with hot receptacles for plates, a full-range electric cooker, an electric wash boiler and heating apparatus has been provided

---

It is Mr. Beauchamp's expressed opinion that the electrical industry has not, so far, and in any general way, shown a grip of the essentials for making the most of their business in the way that the gas undertakings have done. Public services of heat energy are peculiar in this respect that the consumer has more to do than merely to obtain the connection or service; he requires appliances less permanent and more complicated than those needed for the use of water, appliances which require a certain amount of attention to keep in a proper state of efficiency, and some degree of knowledge and intelligence in their use. In addition we find in both gas and electricity services that the consumer, who after all does not want gas or electricity but the services they render, has to rely upon the assistance of at least three groups within the industry concerned.

According to Mr. Beauchamp the consumers requirements are (1) a continuous service of gas and/or electricity as cheaply as he can get it; (2) appliances for its conversion into light, heat or power; (3) the "installation," piping, cabling and connecting up, maintenance and repair. The gas industry is much older than ours and in most cases has developed a closer supervision over these three activities. Upon this joint working for the good service of the consumer success depends, even more than upon price; and the work of the inventor and manufacturer, the local business of the installation contractor, and the sales policy of the gas or electricity undertakings, need to be closely co-ordinated if the best results are to be obtained. Many gas undertakings provide brilliant examples of this co-ordination, and to-day the electrical industry is steadily and in some places even rapidly approaching a similar standard. Nevertheless in many instances to-day this close connection does not exist, the electricity supplier thinking only of his consumer in relation to the electricity used and paid for, and the contractor or manufacturer often enough pushing all sorts of appliances and proposals without proper regard to the supply conditions in different districts.

An electric or gas apparatus which puts the coal range right out of action is a big smoke reducer. Most ranges are stoked very frequently when in action, and generally forced first thing in the morning to get hot water, fed as they are from the top they do produce a great deal of smoke until the whole range is hot and working steadily. The present dearness of coal is a blessing, if a disguised one; it has probably changed methods even in cities like Manchester. The electric method teaches us not only to use heat efficiently, but to do with less of it by alteration in method; the air-tight electric oven, capable of roasting meat with one-fifth to one-eighth of a unit of electricity per pound weight, is an example; the heat may be of a finer or dearer texture, so to speak, but it acts inside the oven, close to the meat, and very little of it is lost.

So far electric cooking appliances, at least the range, have evolved on lines similar to gas apparatus, even as that evolved out of the coal fire cookers which preceded it. With the electrical method, however, there is more room for departure from conventional ways of cooking food, and slowly kitchen methods will change and take the fullest advantage of the ease of direct heat application, and of the facilities for dividing up heat application to cookery which electricity affords. When we consider the very small amount of heat energy which is really absorbed by a given quantity of raw food to bring about the physical and chemical changes which make the difference between raw and cooked, it is obvious that there is room for great progress yet, and that progress will probably be easier with electricity than with any other medium.

—And Refuse Destruction.

Meanwhile the authorities responsible for the collection and disposal of domestic refuse are beginning to preach a gospel which is in a sense opposed to that of the smoke abaters. At a recent inquiry into the Southend Town Council's application to borrow £19,000 for the extension of the refuse destructor the inspector said that if occupiers would burn their refuse in their own houses the cost of this service in the country would fall by one million pounds a year straight away—that was, if people would only use their own fireplaces. There was in English refuse every year four million tons of coal. In Southend they were facing a very heavy collection cost. Every ton burned in houses would save the town fourteen shillings on the average. It was surprising how wasteful they had become. This service was costing £12,000,000 a year. He found that refuse gave a greater heat in his grate than ordinary coal.

This admirable precept would be all very well if it covered only cinders, which are admittedly excellent fuel when used with an admixture of fresh coal, but it is surely not contended that the greater percentage of house refuse consists of partially consumed fuel. My own observations convince me to the contrary, and although every good housewife should make a point of burning perishable materials like vegetable scraps rather than leave it to decay in the dust-bin, and prove a source of danger to health, there is nevertheless a very large percentage of rubbish consigned to this receptacle in the average household the burning of which in the domestic grate would very materially add to the smoke nuisance rather than abate it.

Telephone Enterprise.

There is a movement afoot to popularise the telephone and bring its advantages to the closer notice of the householder, with a view to increasing our popular use of this convenient service. In this connection the manager of the Hull system, which is under the control of the corporation as distinct from the Post Office, is reporting on a scheme for laying telephone wires on the same principle as service mains for electricity, for houses with a minimum assessment of £20, the cost, where it is desired to have the telephone installed, to be covered by a slightly higher assessment. The Sheriff of Hull, whose proposal it is, states that the system is in operation in Stockholm and elsewhere. The suggestion certainly has much to recommend it as compared with the present practice of furnishing a route of overhead or underground wires against problematical growth in a given area and subsequently finding that applications cannot be dealt with promptly on account of the lack of line equipment pending further extensions at a vague and distant date. As it is, many more people would have telephones to-day if they could secure an installation at reasonably short notice instead of having to wait upon developments, which, in turn, presumably, waits upon Treasury sanction.

“ Shop! ”

The British Empire Exhibition has at last “ put the shutters up ” and ELECTRICITY stand has sold its last book and answered the last question—this time, at any rate. It looks very much as if the Exhibition in some form or other will be open next year, but visitors had better be prepared to find ELECTRICITY stand in a new guise. In fact, a kind of “ Whiteley,” for the public expects it of us. Look at the sort of things we were asked for:—Wembley rock, picture postcards, postcards of ships, stamps, Ordnance maps, matches, films for cameras, *Ideas*, gum labels, *News of the World*, hairpins, tiepins, playing cards, china, indiarubber balls, *Pilgrim's Progress*, paper bags. Why, we simply have no option, have we?

What a mess we'd have had if we *had* sold Wembley rock, and customers examined our literature while eating it! Anyway, there would hardly have been need to ask for gum labels then. And hairpins! When the lady with the serious air approached we thought—“ Hello, must be one of those women engineers. Better pull our socks up.” But no, she just wanted hairpins. One can understand the sudden longing for *Pilgrim's Progress*—especially if the engineer was “doing” the whole Exhibition on a one-day excursion trip. It reminds me of a game we were fond of in the days of our youth. Two or three of us would walk into a shop and make an inquiry as to whether so-and-so was in stock. And if it was, we simply said, “ Oh, we just wanted to know,” and then we walked out. But one day, when we thought we had pulled the assistant's leg beautifully for an unusually long time, we suddenly spotted the manager waiting for us outside with a big stick. And as we reluctantly edged out to our doom we understood why there had been such a time lag!

Comments on “ an Electric Age.”

Occasionally in the correspondence columns of the daily Press one comes across a letter which in simple yet direct fashion throws into relief some fact which, mayhap, did not seem of any moment until then. Such a letter is before me now, culled from the *Liverpool Courier*. The writer was dealing with the proposals of Mr. Lloyd George's Committee, and went on to state that four miles up the valley in which he lived a new colliery was being sunk. “ Think,” he says, “ of the development of this valley if that colliery were to supply electricity to the district. *There must be many hundreds of* *similar valleys in the country, yet agriculture is carried on by man-power and a few revolutionary tractors."* The writer did not put his words in italics; it is in this emphatic form that they appealed to me.

A somewhat similar thought came to me but a short while ago when I was a mile or so " in-bye " (as they say) down one of the deepest pits in the north. Here was an electric coal-cutter at work. The energy which drove the coal-cutter was derived from coal which was hewn in that very pit--coal which, by laborious process, was carried in tubs to the shaft, up to the surface, screened, transported by rail several miles to a power station and there burnt under marine boilers. From that coal a pitifully small fraction of its energy became available at the output side of a turbo-alternator; it was transformed to extra-high tension, and through feeders and cables and switchgear eventually arrived at the place it originally came from!

But here is the conclusion of the letter I referred to: " I am writing this by the light of a paraffin lamp, yet Liverpool's boundary is less than two miles away." That seems another indictment, pathetic in its way, but in this case the gas people ought to share some of the guilt. Still, what would you? I write this by gaslight, and I am an electrical engineer. I live in a big town and " juice " is available in the next street, but somehow or other the " powers that be " won't favour " our " street. It's a funny world, my masters.

ELEKTRON.

Correspondence.

INTERNATIONAL RADIO WEEK.

REPORTS ON EVENING TRANSMISSIONS.

To the Editor of ELECTRICITY.

SIR,—May we beg your readers, while the impressions are still fresh in memory, to forward brief reports on the quality of reception they experienced of the 10.30 p.m. to 11.30 p.m. transmissions, whether such reception was—

(*a*) direct from the country broadcasting,
(*b*) via the B.B.C. relays.

Observations, opinions and criticism (especially constructive) are invited, since such comment will be invaluable.

Out of deference to the expressed wish of the B.B.C. practically no preliminary publicity was given to the institution of these evening transmissions. Consequently great numbers of the public are doubtless quite unaware of the aims and objects of the movement, and it may be desirable here to mention that the aim is to bring nations into closer touch by means of national programmes broadcast by each country in turn for the benefit of other participating countries. Such programmes, containing amongst other items addresses by leading personalities, native music by native composers, and other material peculiar to the country broadcasting, will, it is hoped, tend towards the creation of better international understanding and goodwill.

These transmissions must not be confused with the 3 a.m. to 5 a.m scientific tests, with which they have little in common. The evening transmissions were designed for the purpose stated, rather than for their scientific value, and were arranged so that even the crystal user might enjoy a " glimpse " of foreign lands.

The criticism of the lady who has written charging the promoters with causing the bad weather and consequent loss of life through storm havoc is unkind, but everyone is entitled to his, or her, own opinion.

All communications then will be welcomed—even a line on a postcard.—Yours faithfully,

CLIFFORD AND CLIFFORD,
Hon. Secretaries,
The Wireless Retailers' Association,
70, Finsbury Pavement,
London, E.C.2.

December 3, 1924.

Our Wireless Corner.

NEW MULLARD VALVES.

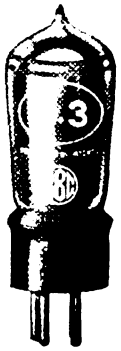
As emphasising the importance of the use of valves for radio work of definite characteristic features to suit the special requirements of the particular class of work they are required to perform, and which most of the manufacturers have recognised, we have much pleasure in referring to a series of six new valves which the well-known Mullard Valve Co., Ltd., are putting on the market.

These valves are all of the dull emitter filament type, and, while operating with very little current, give results of a markedly efficient character.

They possess the ordinary features of design of this company's make of valves, and are of robust construction and fitted with the special moulded insulating cap.

They should appeal particularly to users of portable sets, as well as to experts and amateurs engaged in high-class experimental work and seeking most efficient results with power economy.

We have had the privilege of testing some of these new valves, and are able to testify to the accuracy of the general claims in regard to same as set forth in the company's descriptive lists, as well as to the very satisfactory results in clearness of tone and in the volume of sound reproduction.



The valves are designated under the symbols:—

D.06 H.F.	D.3 H.F.	D.F.A.3.
D.06 L.F.	D.3 L.F.	D.F.A.4.

As the figures indicate, the first four valves, types of which are illustrated, are intended specifically either for H.F. or L.F. amplification, and are so designed that the special requirements for either of these purposes are emphasised in each to suit its particular duty—the H.F. valve being equally efficient as a detector. The amplification factor of this valve is high, being quoted as 17 as an H.F. amplifier—the current consumption of the one being .06 amps. in the filament with a maximum voltage of 3, and of the other .3 amps. with a maximum voltage of 2, the anode voltage in either case ranging from 50 to 125.

The L.F. valve has similar electrical characteristics, but with an impedance about one-fourth that of the H.F. valve, and suitable for most intervalve transformers, and with a good amplification factor given as 7.

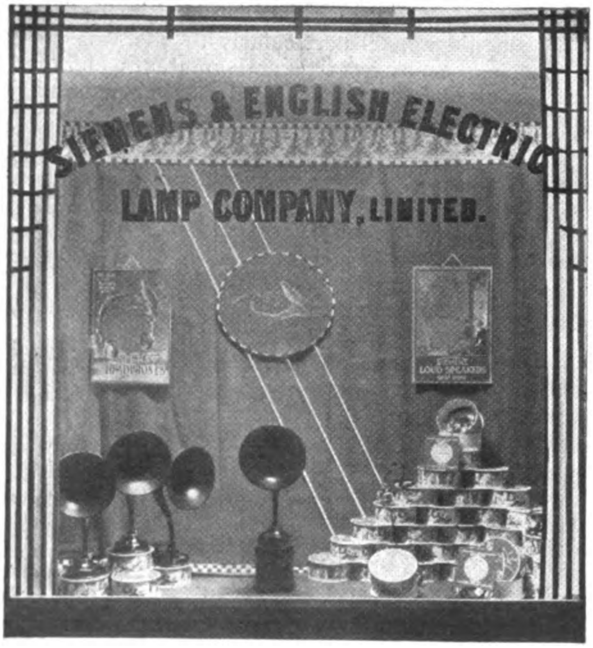
The filament current is similar to the H.F. valve in both types, the anode voltage ranging from 30 to 100. In our own tests with these valves we found that from 60 to 80 volts gave most satisfactory results for distant signals with headphones.

These valves are certain to commend themselves to a large body of users, and, being quite moderately priced for an exceptionally high-class article, should command a large sale.

SIEMENS LOUD-SPEAKERS AND HEAD-TELEPHONES.

A special window display of the well-known Siemens loud-speakers and headphones is being made at the premises of Siemens and English Electric Lamp Co., Ltd., at 38 and 39, Upper Thames Street, E.C.4, as shown in the annexed illustration.

The headphones are put up in very attractive and substantial presentation (collar) boxes, bearing the well-known "Nightingale" design in blue and white on the lid, whilst a series of artistic panels, illustrating listening-in in its various phases, is carried round the side.



THE SIEMENS WINDOW DISPLAY

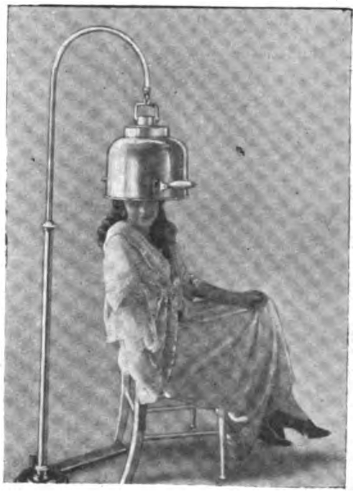
The "Nightingale" showcard is also displayed, and, in fact, provides the dominant motif of the decorative scheme, in which blue and white are the only colours employed. The *tout ensemble* is restful and dignified.

WIRELESS EQUIPMENT ON THE "MULBERA."

The P. and O. liner *Mulbera*, which the Duke and Duchess of York joined at Marseilles on December 5 last for their voyage to East Africa, has been equipped with special wireless apparatus by the Marconi International Marine Communication Co., Ltd. In addition to a long-range Marconi valve transmitter and special long-range receiver, the ship also carries a Marconi marine broadcast receiver, which will enable the broadcast programmes to be received throughout the voyage.

THE "ELECTRODOME": A NEW HAIR-DRYING DEVICE.

The uses of electricity and the inventions of women continue to increase in number and variety. The "Electrodome" qualifies for distinction under both these headings; it is the invention of Mrs. Lillie Rae, and it serves the useful function of drying hair by an entirely new method. We had recently the opportunity of attending a demonstration of this apparatus on the premises of Electrodomes, 1, Central Buildings, Westminster, S.W.1, and were much impressed by its general excellence of design and construction, and particularly by its efficacy in action. It is a device for which there is application in every home, and it should be literally invaluable in hospitals and similar institutions.



"ELECTRODOME" IN USE.

The history of the invention of the "Electrodome" has its element of romance, for the idea came to Mrs. Rae when she was in Burmah in the shadow of Moulmein Pagoda, and the first model was made from a Burmese oil tin heated by live charcoal! This experimental apparatus was so conspicuously successful that the inventor was encouraged to proceed, and, in the latest model as now offered to the public, we have a well-finished article, light and artistic, in which electricity takes the place of the charcoal first used. That electrical operation is much to be preferred, and is, in fact, ideal, goes without saying. The use of the "Electrodome" is simplicity itself. The heating elements are between the double walls of the dome, and the latter can be raised, lowered, or swung round to suit the convenience of the user. The entire weight of the dome is carried by the pedestal and its curved continuation. The user sits with the upper part of her head inside the dome; her hair, piled up if long, is thus subjected to a gentle, uniform heat, which is at once effective in drying the tresses and beneficial to their gloss and strength. Mrs. Rae claims that hair dried by the "Electrodome" grows an inch a month.

An average head of shingled hair is dried in ten minutes, bobbed hair in fifteen minutes, and long hair in twenty minutes. Current supply can be taken through an ordinary lampholder if necessary, and the consumption is almost negligible, particularly as the dome, once heated, holds enough heat to dry one or two heads of hair after current has been switched off. The apparatus does not in any way inconvenience the user, who can read, knit or write whilst the head is being dried. It will be noticed that no fan is employed and there is consequently no draught. Every part of the head is dried equally and at the same time, and the apparatus is perfectly silent. For these reasons, and because of the flexibility of its adjustment it will undoubtedly be appreciated by hospitals and nursing homes, as well as by private users.

In conclusion, it should be stated that the "Electrodome" is an all-British production, and provides so much comfort at such little expense that it may fairly be considered a luxury which is a necessity.

ELECTRICAL ENGINEERING.—FINAL GRADE.*

Solutions to Questions set at the 1924 *Examination of City and Guilds Institute.*

BY EDWARD HUGHES, B.SC., A.M.I.E.E.

(Continued from page 514.)

Q. 6.—Explain how interference with communication circuits can be caused by power lines when fed from (*a*) an alternator, (*b*) a rotary converter.

A. 6.—The frequency of voice currents in a telephone circuit varies between 100 and about 4,000 cycles per second, but the mean frequency of these currents is about 800 cycles per second, which is the figure adopted for telephone transmission calculations. It is for this reason that the worst interference generally results from extraneous currents of frequencies between 800 and 1,200 cycles per second; thus the effect of a current at 1,100 cycles per second is about 1,000 times that of the same strength of current at 25 cycles per second. Since power lines usually operate at a fundamental frequency of 50, it follows that any interference with an adjacent telephone circuit is due to harmonics in the voltage or current wave.

When the power lines are fed from an alternator, harmonics may be caused by any one or more of the following causes:—

(*a*) Presence of slots causes pulsation and oscillation of the magnetic flux under the poles. The former gives rise to ripples on the slope of the e.m.f. wave, whereas the ripples due to the latter appear on the top of the e.m.f. wave.

(*b*) The wave-form of the e.m.f. generated in any conductor is the same as that of the flux distribution around the periphery; and this in turn depends upon the shape of the pole-shoe, the load, etc. By using two or more slots per pole per phase, the magnitude of the harmonics in the terminal voltage wave v is reduced relatively to the fundamental, and may in some cases be eliminated.

(*c*) In the case of a three-phase system having only one earthed neutral, there may be static interference if the phase voltage contains a third harmonic or an odd multiple of the third. If the generators are supplying an extensive system, the capacity currents due to the third harmonic or its odd multiples may be considerable. It may be stated, however, that the third harmonic usually causes more disturbance to telegraphic than to telephonic circuits.

(*d*) Should a second star-point be earthed, the third harmonic of each phase combine to produce a comparatively large current returning *via* earth.

(*e*) If an alternator with an earthed neutral is supplying power through transformers to an overhead line, the distortion of the wave-form due to magnetisation may cause interference. The risk of trouble is greatest when the transformers are connected star-star, and is least when they are connected delta-delta.

Interference may be caused by rotary converters owing to one or more of the following reasons:—

(*a*) Flux pulsation and oscillation due to the armature teeth, as mentioned in the case of alternators. In rotary converters, however, this trouble is accentuated by the slots in the pole-shoes for accommodating the damper winding, especially if the pitch of the damper slots is the same as that of the armature slots.

(*b*) Pulsation of the armature ampere-turns due to the alternating current: thus the armature ampere-turns per pole on a three-phase full-pitch armature pulsates between $\frac{0.47\,I_a C}{2p}$ and $\frac{0.407\,I_a C}{2p}$,

where I_a = r.m.s. value of the alternating current. conductor,
C = number of conductors on armature,
and p = number of pairs of poles.

Further, this pulsation occurs six times per cycle and therefore gives rise to a sixth harmonic on the D.C. voltage wave.

(*c*) Harmonics in the supply voltage on the A.C. side appear as even harmonics on the D.C. side. In ELECTRICITY for August 17, 1923, a full explanation was given of how both a fifth and a seventh harmonic in the A.C. voltage wave give rise to a sixth harmonic on the D.C. voltage.

Any reader who wishes to pursue this subject in greater detail is referred to a recent I.E.E. paper by S. C. Bartholomew on "Power Circuit Interference with Telegraphs and Telephones."

(To be continued.)

A successful business man is never quite able to understand how anybody could be unsuccessful.

---

* Books recommended are *Continuous Current Electrical Engineering* and *Alternating Current Electrical Engineering*, both by Maccall (each 15s. 6d., post free), and *Alternating Current Electrical Engineering*, by Kemp (17s. 6d., post free), from S. Rentell and Co., Ltd., 36, Maiden Lane, London, W.C.2.

ELECTRIC PASSENGER LIFTS.*

By H. Marryat (Member).

(Concluded from page 669.)

The car falling due to failure of support.—This may occur in the case of :—

(a) *The car becoming jammed in the well, whilst the ropes continue to be paid out by the engine above and then becoming free and falling to the extent of the slack rope. (This is a class of accident confined to drum-driven lifts.)*—In the case of traction drive, if the car or counterweight jam, the result is either an extra load which causes the main fuses to blow, or a relief of load which causes the traction sheave to revolve harmlessly within the slackened rope. In the case of drum drive the counter provision is the slack-rope safety switch applied to both car and counterweight ropes in such a way that if any one of these ropes slackens, the switch will operate and cut off the main supply current.

(b) *Fracture of the supporting ropes.*—The counter provision is a safety gear attached to the car sling and operating as above described, to support the car by friction upon the guides in the event of the ropes breaking. In the best form of such safety gears the wedging action takes place and the car is brought to rest in the event of any one of the supporting ropes stretching beyond a certain limit. As a rope invariably stretches before breaking, the result is to anticipate a break taking place. If the well is totally enclosed and fitted with doors necessarily locked before the car can be set in motion, it is possible to use the column of air below the car as a cushion to prevent the too rapid descent of the car. Suitable buffers may also be employed as an additional protection.

(c) *The ropes becoming disengaged from the winding engine.*—This is a most serious class of accident, because if the safety gear on the car is operated by the supporting ropes themselves, or by a cord passing over the same sheave and therefore probably disengaged like the ropes, the result is that the safety gear is inoperative and the car and counterweight fall together without any brake. Ropes may leave the top sheave during the momentary slackening due to a jam of the car or counterweight, and from other causes. The counter provision is the employment of a centrifugal governor or other device to operate the safety gear by means of a cord reeved over pulleys entirely independent of those over which the supporting ropes pass. In this connection the extreme danger of using an overhung traction sheave may be noted. There should always be a substantial bearing on each side of the sheave so that the ropes—if by any means they are thrown off the sheave—cannot fall clear.

Three typical forms of safety gear, as usually applied to the cars of passenger lifts, are illustrated in the lantern slides.

The safety gear is now usually fixed below and not above the car. This is a wise precaution, as cases are on record in which the car has become detached from the gear fixed to the sling above and has fallen unchecked into the well.

It is not usual to attach a safety gear to the counterweight, except in places where the well does not descend to the lowest level and the counterweight might therefore fall into an inhabited space. Nevertheless, if it were the invariabl practice to equip the counterweight with safety g [illegible] accidents might be rendered less serious in tl [illegible].

(d) *Failure of a portion of t [illegible] al gear allowing the traction sheave or dru [illegible] revolve under the influence of the loaded car or co [illegible].* This may happen if the keys fixing the [illegible] ave or worm-wheel fail, or the rim of the worm-wheel becomes detached from its centre, or the teeth of gears wear out or fracture. The only preventive, apart from sound design and construction, is regular inspection, but if the lift is allowed to get into a state in which such an accident can occur, the centrifugal safety gear—if designed to operate in both directions of travel—will check and support the car.

A passenger becoming crushed between the moving car and some portion of the lift well.—This cannot happen if a gate is fixed to the car entrance and so interlocked by means of a contact on the gate with the control circuit that it is impossible to move the lift unless this gate is completely closed.

Car starting whilst passenger is entering or leaving.—The counter provision is electrical interlocking contacts on both landing and car gates, preferably connected on opposite poles of the circuit.

Falling into the lift well.—The counter provision is a mechanical lock upon each landing gate, rendering it impossible to open the gate from the outside unless the car is at the landing in question. These locks are released by a ramp on the car which operates a roller connected with the gate lock.

A gate lock, to be absolutely reliable for use on an automatic lift, has to meet a great many requirements, and many of those already installed are defective in one way or another. Locks are now available which do meet all requirements and are safe. Existing locks of the older types should be exchanged for these.

One of the conditions of the perfect gate lock is that it shall not allow of the gate being opened when the car is only passing and not stopping. This condition can be complied with by the employment of a movable solenoid-operated ramp on the car, but the complication is not usually considered worth troubling about, because the effect of opening a gate whilst the car is passing is only to stop the lift, and the result, though annoying to the passengers, is not dangerous

The other accidents which may occur on electric passenger lifts mostly concern men engaged upon construction and maintenance and do not come within the reach of this paper.

It will be observed that in order that a passenger lift may be safe it must be provided with a number of mechanical and electrical safety devices. In the design of these the guiding principle must be that any failure of the safety device itself, whether mechanical or electrical, shall only result in rendering the lift inoperative. If this principle is faithfully carried out the lift will be put out of use upon the least derangement of any one of the large number of minor parts. The only steps which can be taken to prevent this are regular inspection and adjustment by men trained to the business.

As it is not desirable to allow wearing parts, ropes, bearings, gear, etc., to wear to anything approaching breaking point, inspection is necessary to ascertain when renewals should be made. The frequency of such inspection may vary considerably, according to the amount of service the lift is called upon to perform, but I have found it reasonable to insist upon an inspection after ev[illegible] journeys, with a maximum interval of th[illegible] between inspections.

---

* Paper read before the I.E.E.

Reviews of Books, &c.

[Books noticed in this column will be sent from Electricity *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

British Standard Classification of Pure Mineral Lubricating Oils: Publication No. 210-1924.—Following the issue of the British Standard Specifications for Fuel Oils for Heavy-Oil Engines, the British Engineering Standards Association has now published a B.S. Classification of Pure Mineral Oils.

This classification is intended to be a broad guide to users of pure mineral lubricating oils to enable them to describe their wants in a more precise manner than is now frequently done. The meaning of the terms "Light," "Medium," "Heavy," etc., as applied to lubricating oils is clearly defined in terms of definite ranges of viscosity, thus removing all doubt that may exist in the minds of users of oils as to whether these terms refer to the viscosity or the specific gravity of the oil. Typical specifications for each type and grade of oil are given, but it is not intended that these specifications should be used as purchasing specifications. The classification has been made under four main heads, as follows:—

(*a*) Machinery and Engine Oils (pale or red).
(*b*) Internal-combustion Engine Oils (pale or red).
(*c*) Steam Cylinder Oils (dark).
(*d*) Steam Cylinder Oils (red).

Oils containing fatty oils have not been included.

Extensive notes are given indicating the purposes for which each grade and type of oil is best suited, and full details are given for the testing of the oils, the methods of testing described being those recommended by the Institution of Petroleum Technologists.

This classification should prove very useful as a guide in drawing up specifications for oils for particular classes of work, for which purpose the typical specification given for the corresponding type of oil should, if necessary, be narrowed down to suit the purpose in view, and additional clauses added setting forth the special characteristics required.

Copies of the Publication (No. 210-1924) may be obtained from the B.E.S.A. Publications Dept., 28, Victoria Street, London, S.W.1, or from Electricity office, price 1s. 2d. post free.

Telephony, Including Automatic Switching. By Arthur Bessey Smith, E.E. (Chicago: Drake and Co.) London: Rentell; 12s. 6d. net.)—Published at a time when Automatic Telephony is rapidly displacing C. B. Manual Telephony in this and other countries, this admirable work from the pen of such an authority on the subject is a fitting addition to the none too plentiful literature dealing with this important subject.

Most authors handle the subject of telephony in too abstruse a manner and confine their explanatory text mainly to the tracing out of circuits as shown on accompanying diagrams; not so the present author, whose book is remarkably readable and withal interesting from cover to cover.

Eschewing early history of the subject and obsolete descriptions, Prof. Smith takes his readers through a complete synopsis of the subject from the simple receiver and local battery working, through common battery practice to automatic switching with all its latest developments, including the Strowger Director which has rendered possible the efficient automatic telephoning of Greater London.

From the student's and telephone engineer's standpoint the style of treatment is all that could be desired, and we unhesitatingly commend this book as the best all-round text book on modern telephone switching yet published, and at a very moderate price.

If we may criticise at all, we deprecate the all too brief allusion to C.A.X. (Community Automatic Exchange) practice, which is dismissed in four lines on page 246, and the claim that the Strowger Director lies solely to the credit of the Automatic Electric Co. of Chicogo. We believe we are correct in attributing a considerable proportion of the credit for the design of the latest Director to the British company, Automatic Telephone Mfg. Co., of Liverpool, which is at present manufacturing the director equipment for the telephoning of London. Moreover, the accompanying illustration does not depict the latest form of this ingenious device with its accompanying "translator" for the convenient arrangement of exchange codes.

The description of the Director is particularly clear and comprehensive, a fact which will in itself commend the book to Post Office men who are desirous of improving their knowledge of the new system.

We also commend the chapter on testing and adjustment, which, though brief, embodies much useful information for the instruction and guidance of maintenance men.

The illustrations and diagrams throughout are clear and a credit to the publishers.

I.E.E. INFORMAL MEETING.

At the informal meeting on Monday, November 24, Mr. J. W. Beauchamp was in the chair when Mr. N. A. Allen opened a discussion on "The Use of the Electrostatic Wattmeter for the measurement of Dielectric Losses in Cables."

Mr. Allen had a large number of lantern slides showing a variety of methods of connecting up the wattmeter to obtain different readings and check readings, either for factory lengths of cable, or for quite small pieces of dielectric. The particular appeal of the subject attracted a number of members new to the informal meetings, and the few specialists who contributed to the discussion provided a debate of the greatest interest.

Mr. G. L. Addenbrooke thought the whole question of dielectrics of such importance that the paper was worthy of a full meeting of the institution. His own investigations had brought him to the conclusion that dielectric losses are due to minute particles of water which become ionised under electrical pressure. If we could get rid of this moisture, we should get infinity resistance. Work on dielectrics is most promising for electrical discoveries. Electricity, as we know it, has resulted largely through the investigations originally undertaken on submarine cables.

Prof. J. T. McGregor Morris asked if the use of the electrostatic wattmeter in compressed air had been considered. He felt it was a more suitable medium than one used in oil, as developed by Dr. Rayner.

Mr. A. Rosen recalled the nul method of testing, as described by Dr. Owen in "Proceedings of the Physical Society, 1923." He preferred, however, a bridge test, as he had found it more flexible.

Mr. A. J. Tracey reminded the meeting that commercial tests of cable lengths require immersion in water and introduce entirely new conditions. He felt that if it were possible to isolate losses in a three-phase cable, it would be found that 75 per cent. are due to the fillers. Closer regard to the composition of the filler would, he was sure, result in considerable improvement.

Messrs. J. W. Beauchamp, A. Collins and R. M. Longman also spoke, and Mr. Allen replied.

Various Items.

"**Discovery**."—The Christmas number of this well-edited scientific magazine contains various items which will interest many of our readers, and we can cordially recommend it to their notice.

Tenders Accepted.—The Royal Mail Steam Packet Co. have accepted the tender of the Siemens and English Electric Lamp Co. for the whole of their requirements for electric lamps (vacuum and gas-filled) for the first six months of 1925.

North-West Midlands.—The Electricity Commissioners give notice that they have provisionally determined the area of the N.-W. Midlands electricity district, and an inquiry in connection therewith will be held at a later date. Full particulars may be obtained on application to the Secretary at Gwydyr House, Whitehall, London, S.W.1. Meantime, we can state that it includes the County Borough of Stoke-on-Trent and certain adjacent districts in the counties of Chester, Salop and Stafford, as well as the municipal boroughs of Newcastle-under-Lyme and Stafford.

Belgian Congo.—A report on the trade opportunities in the Belgian Congo has just been issued by the D.O.T., and may be obtained from H.M.S. Office or ELECTRICITY Office, price 1s. 8d., post free. In it there is a section on the openings for British trade which should be followed up by all enterprising firms, as well as a paragraph on water power, and other items of interest to engineers generally.

Lurgan (Co. Armagh).—At the monthly meeting of the Urban Council last week, Mr. J. S. Carrick presiding, the questions of completing the town's electric lighting scheme came up for discussion. A letter was read from Mr. Pleasance, the electrical engineer, stating that it was feasible to complete the scheme for the sum of £10,000, and it was finally agreed to meet him and go into the whole details of the scheme with the object of having it completed.

Bibliographical.—The current issue of the *Horological Journal* contains an excellent biography of Mr. F. Hope-Jones, M.I.E.E., F.R.A.S., who was unanimously elected Chairman of the British Horological Institute at the last monthly meeting, and as Mr. Hope-Jones is widely known to the majority of the readers of this paper as the inventor of the Synchronome Electric Clock System, we think that they will be interested in the biography referred to. It gives a good account of his life and inventions, and we can extend our most cordial congratulations to him on the honour to which he has been elected.

Meetings.—The Junior Inst. of Engineers will meet on Friday, 12th inst. Paper, "Fluid Transmission Gears," by H. G. Bouly; slides. Also, on Friday, 19th inst., lecture, "Aircraft in Japan," by Col. The Master of Sempill; slides. And on Friday, Jan. 2, lecturette, "Modern Flour-Milling Machinery," by Wm. Ringrose; slides. All at 39, Victoria St., at 7.30 p.m.

Meetings.—The Illuminating Engineering Society will meet at the E.L.M.A. Lighting Service Bureau, 15, Savoy Street, Strand, at 7 p.m. on Tuesday, 16th inst., when there will be further particulars and demonstrations of recent advances in electric lamps and lighting appliances.——The Inst. of Production Engineers will meet at 7.30 p.m. to-night, 12th inst., at the Engineers' Club, Coventry Street, W.1. Paper, "Heavy Machine Tools," by Mr. C. D. Andrew, of Armstrong-Whitworth, Ashton Road, Openshaw.

Shannon Scheme.—Within a few days the Free State Government will, it is expected, be in possession of a preliminary report from the four Continental experts to whom proposals of Messrs. Siemens, the German engineers, for the harnessing of the Shannon, were submitted for examination.

Quotations Wanted.—The Municipal Council of Johannesburg invite tenders for the supply and delivery of transformers.——Also for the supply of electric cable.——Also for the supply of one Board of Trade traction testing panel, and for the supply of tramcar motors and spares.—A copy of the specification and general conditions of tender is available for inspection by British firms at the D.O.T. (Room 52), 35, Old Queen Street, London, S.W.1.

Quotations Wanted.—The Uruguayan State Electricity Supply Works at Montevideo are inviting tenders for the supply and delivery of five distribution switchboards complete with instruments, etc., for five inland towns, and one power-station generator panel equipment. Specifications, etc., can be seen by British firms interested at the D.O.T. (Room 52), 35, Old Queen Street, London, S.W.1.

Trade Notes.

Under date September, 1924, **Brittain's Electric Motor Co.**, of 110, Cannon Street, London, E.C.4, are issuing a circular-letter and illustrated leaflet directing attention to their new types of A.C. motors, all of which are made to the B.E.S.A. specification. They also refer to their hand-operated friction clutch, which does away with the necessity of adopting commutator types of motor, thus abolishing many causes of trouble. Further, they have recently established a special repair department, where they can alter all classes of motors and give special attention to the rewinding of any type where the supply is being changed from one periodicity to another. Any installation contractor or trade reader who has not yet received a copy of this circular should make a point of writing at once and asking for it, mentioning this notice.

The Editor of the September issue of the *Henley Telegraph* is to be congratulated on the general tone and get-up of this very excellent house organ. The concluding portion of the article dealing with the early life of Mr. W. T. Henley is indeed most interesting, while the other articles, such as "A Sussex Nook," "Social Club Notes," "Sea Air," etc., are all capitally written and well worthy of careful perusal. Needless to say, the humorous side is also to the fore, and there will be many a smile at the article headed "Instruction in Braiding."

GRINDERS
DRILLS
"DEPENDABLE"
& POLISHING LATHES
MARRYAT & PLACE, ENGINEERS.
20 HATTON GARDEN, E.C.2.

Sample Pair Sent on Approval for 8/6.

Made of Pure Para Rubber, soft and durable and unaffected by climatic conditions
DAVID MOSELEY & SONS,
Limited
ARDWICK MANCHESTER.

MOSELEY
RUBBER GLOVES

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

DECEMBER 19, 1924.

CONTENTS. PAGE

A Novel Method of Starting Polyphase Synchronous Motors .. 693
I.E.E. Informal Meeting 694
Our Wireless Corner 694
Questions and Answers by Practical Men 696
Current Topics 699
The G.E.C. Bandit Alarm System 701
Telephony 701
Practical Electrical Engineering Hints 702
"The Animals Went in Two by Two" 703
An Elementary Investigation of the Energy of a Magnetic Field 703
Reviews of Books 704
Various Items 706

A NOVEL METHOD OF STARTING POLYPHASE SYNCHRONOUS MOTORS.*

By E. V. Clark, B.Sc., Associate Member.

(Paper first received November 19, 1923, and in final form March 31, 1924.)

(Continued from page 681.*)*

Once the synchronous motor is properly running on the asychronous alternator circuit, one may, of course, increase the field strength gradually with advantage to the torque transmitted. It would appear, however, that a sudden increase of field strength would momentarily cause the synchronous motor to give out energy, and might therefore pull it up if the speed were too low.

Attempts to start up a single-phase synchronous motor in this manner met with very little success. The same two laboratory machines were used, with one of the three-phase star-connected legs disconnected. By giving the greatest possible hand-turn to the synchronous motor one could occasionally get it to hold in, but this result was exceptional. The method might prove useful occasionally in running up to speed a single-phase machine that could be driven mechanically to, say, one-quarter full speed, but does not otherwise appear to afford much scope for use.

This method of starting polyphase synchronous motors would appear to have little scope for use in the factory, since it suffers from three defects. First, excitation must be available while the motor is at rest; secondly, a hand-turn or its equivalent must be given at starting; and, thirdly, even though the asynchronous alternator may run at full speed throughout, yet there must be no pressure on the mains between the alternator and motor prior to the moment of starting. Nevertheless, it is not impossible to devise a scheme for the operation of a factory with a number of small synchronous motors to be started on this principle and operated from public supply mains. A control centre would be provided from which all motors would be started, and this would be equipped with an induction motor driving both the common exciter for all synchronous motors and also the starting asynchronous alternator, which would have two poles more than the motor driving it. This set would run continuously while the factory was working. Each synchronous motor (with the exception of very small ones) would drive its load by means of fast and loose pulley or friction clutch, and would be connected to the control centre by five wires, viz., three A.C. armature leads and two D.C. exciting leads. The control switchboard would include for each synchronous motor a field switch and rheostat and a three-pole double-throw main switch, connecting to the starting busbars in one position and to the public mains in the other, with intermediate "off" position. Starting busbars would be connected through an ammeter to the stator of the asynchronous alternator, the rotor of which would be wound and provided with a substantial three-legged rheostat. A synchroscope would be connected between the starting busbars and the public mains.

To start any motor, the workman operating it would signal by bell-push that he desired it to be started, and would proceed to rotate it by hand. The switchboard attendant at the control centre would put the rotor rheostat of the asynchronous alternator on to the first notch, throw the main switch of the synchronous motor in question into the starting position, and then close the field switch of that motor. His ammeter would indicate directly the motor started, and he would then bring the latter up to speed by means of the rheostat in the alternator rotor, keeping, if desired, the motor at the low speed of the first notch until he got a signal to tell him that the friction clutch was closed, or the belt transferred to the fast pulley. As the asynchronous alternator has two poles more than the motor driving it, the synchronous motor will readily run up to synchronous speed with respect to the supply mains; and the operator must synchronise in when throwing his motor switch from the starting position to the running position upon the public mains. He thus has entire charge of all motors, and by varying the exciting current either individually or collectively may keep the power factor in the neighbourhood of unity, or leading, as required. Any motors in the factory which have to start and stop frequently—*e.g.*, crane motors—may be of the induction type and have their bad power factors neutralised by over-exciting the synchronous motors.

This scheme is merely put forward as indicating the technical possibility of operating a number of synchronous motors with this method of starting, for it is fully realised that the complexity of the scheme renders its commercial utility extremely small. In special circumstances, where a large number of small motors was desirable and power factor of prime importance, and where, in addition, labour was very unskilled, it might be advisable to install a system of synchronous motors with centralised starting and a common exciting source; but even under these conditions results could probably be obtained more satisfactorily by using synchronous motors equipped with amortisseur coils, so as to be self-starting and self-synchronising, and providing at the control centre a starting transformer with tappings. This would eliminate the hand starting and hand synchronising which would appear inseparable from the method of starting by means of an asynchronous alternator.

---

* Paper read before the I.E.E.

There should, nevertheless, be some practical use of this method of starting synchronous motors and three fields may be cited where it should have possibilities.

(*a*) In technical school laboratories, where it may be used both to illustrate the properties of the asynchronous alternator and to start up synchronous motors for the plotting of V curves, etc.

(*b*) In manufacturing works' testing shops, to start up alternators in order to parallel them on to the A.C. supply mains, whereupon they may be tested as motors, either running light or by means of a rope brake.

(*c*) In sub-stations, for emergency starting when the normal starting gear is broken down, in cases where an induction motor set is available. For example, Stuart Street Station of the Manchester Corporation some twenty years ago contained an induction motor-generator set for exciting the main alternators. By means of this it should have been possible, without any temporary connections whatever, to start up on the A.C. side any motor-generator sub-station in which D.C. excitation was available, provided that the requisite "hand-turn" could have been given to the motor-generator set.

The author's thanks are due to Mr. W. G. T. Goodman, chief engineer and general manager to the Municipal Tramways Trust, Adelaide, for permission to carry out tests at one of the tramway converter stations; and to Mr. A. A. Watkins, chief assistant engineer, both for arranging the temporary connections necessary to enable the tests described to be carried out on one of the spare sets in the converter station, and for much assistance while the tests were in progress.

I.E.E. INFORMAL MEETING.

At the meeting of the Informal Section on the 8th inst., Mr. J. Coxon was in the chair when Mr. G. M. Clark, M.A. (Cambs), delivered a lecture entitled "A Walk Round Pretoria Power Station." He showed a large number of lantern slides of the station during all stages of erection and from all aspects, including one view from an aeroplane, showing the site and the surrounding country. A 36-acre lake formed by a dam adjoining the station is prominent in the bird's-eye view, for surface-water cooling was adopted because the water could be put to additional services.

Mr. Clark referred to the bad old days when it is alleged the manufacturers of a machine that tested out to be a "dud" pondered on the alternative of scrapping it or sending it abroad. Whether this slur be warranted or not, the Dominions to-day certainly ask for our best and see that they get it.

The Pretoria Electricity Works is a splendid example of the way difficulties of transport and of labour can be overcome in the more remote places of the earth.

The new station is some four miles outside the town, where the old station has been turned into a converter station.

The new site and its surroundings are municipal property, and civic pride seems to have influenced the policy governing the improvements Mr. Clark described.

A comprehensive schedule of figures showed some remarkably good results and also some enviable efficiencies, but Mr. Clark stated that a 40 per cent. load factor is by no means uncommon in South African towns.

A very low-grade coal, costing 1s. 6d. per ton at pit-head, is carted 80 miles at a cost of 6s. 9d. per short ton for freight. This was the most notable factor in the figures.

Our Wireless Corner.

INTERNATIONAL RADIO WEEK.

EVENING TRANSMISSIONS.

A statement has been issued by the hon. secretaries of the Wireless Retailers' Association, and appeared in last week's issue, with regard to the results achieved in the evening transmissions by various nations in connection with International Radio Week.

In the first place they point out that the broadcast which took place between the hours of 10.30 and 11.30 p.m. G.M.T. must not be confused with the transatlantic tests carried out between the hours of 3 and 5 a.m. G.M.T. The latter were of a purely scientific nature, whilst the former were primarily designed as the inauguration of a movement to promote intercourse, appreciation and good will between the nations of the world. It is claimed that the results obtained have demonstrated the great potentialities of wireless as perhaps the best existing means of removing misunderstanding and encouraging international friendship.

In the course of the week music and speech were broadcast in turn from Great Britain, America, Belgium, Denmark and France. With the exception of Denmark, these transmissions were rebroadcast by the B.B.C., and were clearly audible to millions of listeners throughout the country. Even users of crystal sets were enabled to participate, and reports so far received show that the keenest interest was awakened. The excellent national programmes arranged by each of these countries, who thoroughly entered into the spirit of the movement, and the speeches delivered expressing cordial good will to the nations participating were greatly appreciated. Unfortunately in the case of Belgium it was not found possible to commence relaying until after the address had been delivered.

Although it had been confidently affirmed by some experts that not so much as a syllable would be heard from America so early in the evening, the prophets were confounded, and the best rebroadcast of KDKA yet accomplished took place between 11 and 11.30 p.m. on Wednesday, November 26, when, atmospherics notwithstanding, well-known pieces, including a singularly good cornet solo, and most of the announcements, were relayed to all stations in this country. The great part played by the engineering department of the B.B.C. in picking up and relaying the transmission is deserving of the highest praise. Reports by European listeners in response to KDKA's appeal will be forwarded if addressed to W. R. A., 70, Finsbury Pavement, E.C.2.

The only jarring note of a most successful inauguration was struck by a lady who wrote: "I hope you are satisfied with the weather conditions due to International Radio Week and the consequent damage to property and loss of life."

Several countries have already indicated that they will be pleased to participate next year, including Sweden, whose Royal Board of Telegraphs point out that their western coastal stations will then be operating.

A GREAT WIRELESS EXHIBITION.

The third annual Chicago Radio Exhibition has just been held, and it is probably the biggest exhibition of its kind so far held in the world. It was certainly a most wonderful show, and we in this country can no doubt learn many lessons from the details given of the exhibits, and these will to some extent point to the immediate developments of wireless transmitters and receivers.

In order to encourage inventors, prizes were awarded for successful inventions of merit, and endeavours are being made to assist in marketing some of these inventions to the best possible advantage. This alone should be a great lesson to our British radio trade in general.

The decorative side was most elaborate, the whole arrangement and layout of the show being entrusted to architects, artists and scenic designers of note.

A number of the American broadcasting stations were established actually in the exhibition, and carried on their programmes in the ordinary way.

Complete receiving sets of all kinds were on view, including an instrument known as "The Rolls-Royce of Radio," about the size of a small upright piano, probably the most artistic receiver ever built, and incidentally the most expensive. The exhibits were not confined to American manufacturers, and companies from Japan, Germany and France were well represented.

The great lesson learned from the exhibition is that quality and efficiency holds the day, and in the main cheap products are conspicuous by their absence. At one time the American radio market was flooded with cheap and nasty material. To-day, taking the American trade as a whole, they claim that it leads the way for quality production.

AN I.E.E. PAPER.

A paper entitled "Wireless Telegraph Valve Transmitters Employing Rectified Alternating Current" has just recently been read at the Institution of Electrical Engineers by G. Shearing, B.Sc., M.I.E.E.

The paper describes the development of some of the valve transmitters employing rectified power for naval purposes, from December, 1918, onwards. The earlier work is briefly reviewed and general considerations of design for ship conditions are dealt with.

A description is given of the method of calculation of the geometry of the rectifying valve electrodes and of the power loss.

Some of the types of transmitter circuits employed are described, also detail circuit improvements for satisfactory working.

Arrangements of valves in series and the use of coupled circuits for drying-out wet aerial systems, also separate grid excitation circuit arrangements, are dealt with.

Experimental circuits for the reduction of harmonic interference, also the arrangements adopted for signalling by grid potential control, are discussed.

Finally, the design of the transmitting valve electrodes is dealt with and the question of valve rating is discussed.

Anyone interested in the subject is advised to obtain a copy of the paper, as it is not possible to extract in any detail the information which it conveys.

The subject is clearly dealt with in the paper, where many diagrams are given and explained.

WIRELESS IN AMERICA.

There has recently been some interesting exhibitions in the United States, where great enthusiasm prevails in connection with this industry. They call them Radio shows there, and it appears that there is considerable rivalry between the main centres of commercial importance, each of which is anxious to out-do the others in attracting public attention, and the ensuing lucrative business results connected therewith when successful.

In the final report of the auditors the figures connected with the Third Annual Chicago Radio Show—claimed to have been by far the most successful industrial Exhibition ever held in that country—it is stated that over 173,000 people were "drawn" in six days as compared with 175,000 at the great New York Radio Show in seven days, while the business actually transacted was more than double—some 6½ million dollars worth of orders having been booked, and many exhibitors already full up with orders taken elsewhere were unable to accept new business offered.

Amongst the orders taken from foreign buyers it is to be noted that considerable amounts figure as relating to Melbourne, Sydney, Western Australia and Tasmania, as well as to Southern and Central America, indicating good fields for enterprise for manufacturers.

The interest taken in these shows and their undoubted success emphasise the fact that the radio industry is one of the most important of the age, and of almost universal extent.

The unlimited possibilities of the new science, and the rapid advances which are being made almost daily in every branch of it, make it appear certain that interest in wireless applications and development will increase rather than diminish for at least another decade.

Allowing for American enthusiasm, it is not difficult to understand that some of the ideas put forward and hinted at, as being in various stages already on the horizon of practical application, may not be considered chimerical, although at present possibly regarded as mere fairy tales. For instance, we are encouraged to expect very shortly the advent of a system for transmitting light, heat and power by wireless as a commercial proposition, another proposes refrigerating effects by the same means, and still another cinematograph effects for both reception and transmission.

It is intimated that the 1925 show will completely overshadow any shows of this year.

Would-be exhibitors—line up.

NEW LITERATURE.

From the General Radio Co., Ltd., of 235, Regent Street, London, W.1, we have received two new folders dealing respectively with special wireless goods suitable for Christmas gifts, as well as with other types of wireless apparatus for the general trade. The catalogues should therefore be of direct interest to all radio dealers, and we recommend early application for copies.

Questions and Answers by Practical Men.

RULES.

Questions: We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.

Answers: A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at the top left-hand corner of all letters intended for this column.

Question No. 193.

I wish to electrify a half-ton hand winch. This is used to lift wood to a height, through a derrick, of 45 ft. I would appreciate full details as to how the electrification can be carried out. The power supply available is 440 volt three wire.—"A. Baker," Croydon

Question No. 194.

Can any reader tell me how I can best make micanite paper for insulating armature coils for 600 volt traction motors?—"E. A. B." Wimbledon.

(Replies to Questions Nos. 193 and 194 must be received not later than December 27, 1924.)

Answers to Questions.

Question No. 187.

I wish to use a 100 volt., 3 amp. D.C. motor on 210 volts. Can any reader tell me how to construct a resistance to enable this to be done, since I am told that this is the most economical way of doing it?—"H. W. May."

Replies To Question No. 187.

The first prize (10s.) has been awarded to "E. M. F." for the following reply:—

Your correspondent, H. W. May, seems to have been misinformed, for to reduce the voltage by means of a line resistance is certainly not conducive to economy, and, moreover, apart from the question of economy, such an arrangement has other objectionable features, *e.g.*, instability of motor speed with varying loads.

With the existing windings the motor requires a p.d. of 100 volts at the terminals; therefore, since the line voltage is 210 the resistance must give a drop in volts of $210 - 100$, that is 110 volts at a full load current of 3 amps. Applying Ohm's law we find the resistance must have an ohmic value of $\frac{110}{3}$, or 36.6 ohms.

When running at full load the loss due to this resistance will be (by Ohm's law) $3^2 \times 36.6$ watts $= 330$ watts.

This loss is roughly equivalent to one-third of a unit per hour, so that with energy at 3d. per unit the monetary loss would be one penny for every hour the motor runs at full load.

Further, if the load should fall below 100 per cent. the speed would rise and there may even be a danger of burnt-out armature or field winding due to rise of voltage at the motor terminals, as the following will show.

If the load should fall to 50 per cent. of full value the motor would only require, say, 2 amps. The drop in volts across the resistance would then be ($E = CR$) 2×36.6, that is 73.3; thus the pressure at the motor terminals would be $210 - 73.3 = 136.6$ volts, or roughly 136 per cent. of the rated voltage of the machine.

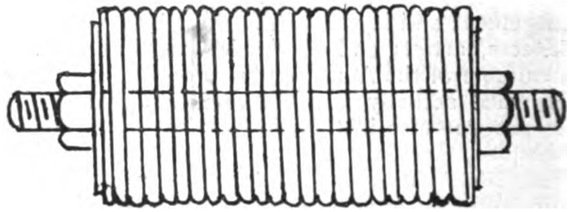
Hence, in addition to the risk of burn-out, due to the increased applied voltage, there would be a corresponding increase in speed.

The correct method of meeting the conditions which confront H. W. May is to have the motor suitably rewound for the revised voltage.

If he still wishes to try the experiment of using a line resistance then I would suggest that wire of a suitable section and length to carry 3 amps and give a resistance of 36.6 ohms be wound on to one or more earthenware cylinders. Such cylinders can be obtained grooved in the form of a screw thread to receive the wire and prevent the turns from becoming short-circuited.

The cylinders may be mounted on an iron rod as shown in the sketch.

Rods and cylinders may then easily be mounted in an iron box, such as is used for a motor starter. The front of the box could be covered with a piece of slate carrying the two terminals, to which the ends of the resistance wire would be anchored, and the whole could then be protected with an iron cover if necessary.



In fact, the structure would be mechanically similar to an ordinary faceplate motor starter without the contacts or automatic releases. It may even be found convenient to utilise an old motor starter for the purpose.

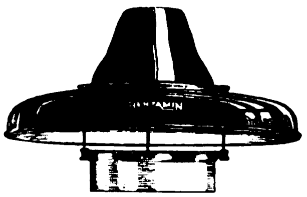
As regards the resistance wire, it is best to use an alloy having a negligible temperature co-efficient so that the ohmic resistance will vary but little between the minimum and maximum temperatures. There are a number of suitable alloys on the market, and makers will be happy to supply data relating to resistance and carrying capacity of various gauges.

For example, one might use No. 20 gauge "Ferry," which at a temperature rise of 100 degrees C. will carry 3 amps and has a resistance of 656 ohms per 1,000 yards. Thus the total length required if this particular kind and gauge of wire is used will be $\frac{1,000}{656} \times 36.6$, or nearly 56 yards.—"E. M. F."

The Second Prize Winner's reply will be published in due course.

From the **Chloride Electrical Storage Co., Ltd.**, we have to acknowledge with pleasure the receipt of the 1925 refill for their desk calendar, which has proved so useful in this office for the year now drawing to a close.

Brilliant Light Without Glare
The BENJAMIN BIFLECTOR



The latest contribution to scientific illumination.

Ideal for Spinning Frames Weaving Looms, Compositors, Frames, Offices, Schoolrooms, Hospitals, etc., etc.

Advt. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited, and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL & CO., LTD., 36-39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

The Trolley-Omnibus.

Judging by recent decisions, it looks as if the trackless trolley vehicle or trolley-omnibus is at last coming into its own and displacing the obsolescent electric tramway for town and city traffic. Some few weeks ago I reported that Chesterfield had decided to scrap its worn-out tramway system in favour of trackless cars, and Keighley has already taken the plunge. Faced like Chesterfield with heavy expenditure on track renewals, estimated at £33,000, in addition to a considerable charge for annual track maintenance, the Keighley Corporation decided to substitute trolley-omnibuses. The general manager of the Keighley Tramways told a lay reporter that for the sum they would have had to expend on track renewals they have been able to equip the system with fifteen trackless trolley vehicles. These are running to timetable, are popular with the public, run very smoothly, and average a higher speed than the old tramcars because of their rapid acceleration. Financially, it is believed that they will prove a sound proposition, and it is estimated that they will cost less than a shilling a mile to run.

Walsall is another town which has decided to substitute trackless trolley vehicles for the present tramway cars. It was stated that miles of track required renewal, and that it would be cheaper in the long run to scrap the system and introduce the system which has become so popular in other parts of the country. Other authorities which have recently realised that tramway systems are out of date by comparison with more modern systems of transport include Leeds, Chesterfield, Sunderland, and the London United Tramways, in so far as the section from Richmond Bridge to Twickenham, which has been losing heavily, is concerned. Even in those cities and towns which have not yet yielded to pressure of public opinion in the matter of tramway obsolescence, the limit of human patience is being reached, as exemplified in the general outcry against the inadequacy of tramway services where such constitute the only available means of getting about, and many municipalities will soon have to grant licences to competing omnibus services or launch out themselves in the alternative systems.

Leeds is a case in point. Up to about a month ago, Leeds, which possesses an extensive municipal tramway service, by no means the least efficient of its kind, prohibited motor-omnibuses from entering the city to pick up or set down passengers travelling between Leeds and the many surrounding towns and villages. This prohibition was, of course, based on the well-founded theory that such services would prove serious competitors of the Corporation's own tramway service. So strong was the local feeling against this ban, however, that the City Council has had to revoke its decision, and has even been driven to passing a motion in favour of establishing local motor-omnibus services. In course of time the Leeds precedent will undoubtedly be followed by many other towns of lesser magnitude, where tramway systems, however efficiently conducted, are no longer able to cope with the requirements of modern traffic. There is absolutely no defence for a city which prides itself on being up to date and yet fears outside competition in passenger transport to the extent of refusing licences to bona-fide private enterprise in the matter of passenger transport. I could name several cities and towns where the municipal tramway system is inadequate for the needs of the business population, and independent supplementary omnibus services would pay hand over fist and still leave a profitable margin for the corporation's tramways.

"Safety First."

We have received from the National Safety First Association two recent publications issued in furtherance of their campaign to minimise loss of life and property, due to avoidable causes. The first, which deals with fire precautions, is an excellently compiled set of suggestions to employers and others for minimising the fire risk in factories and the like. In the introduction it is very properly pointed out that, although affected premises may be covered by insurance and no lives be lost or injuries received in the conflagration, every fire of serious dimensions, nevertheless, represents waste, which is a loss to the community as well as to the unfortunate individual who actually owns the property. According to a report of the Royal Commission, fires directly cost the country over £12,000,000 per annum, whilst probably as much again is involved in loss of wages and output. It is further stated that nearly half the fires which occur are due to carelessness, and could be avoided if the community were properly educated in fire prevention.

The second publication is a small folder embodying "Safety First" suggestions for workers, and is intended for general circulation among the ranks of wage-earners in factories, mines, etc. It contains no fewer than twenty simple suggestions or memory ticklers for the guidance of those who are daily exposed to the risks of industry, and should be memorised by the average worker, no matter what his occupation may be. One very wise axiom relating to electrical plant runs as follows: " Never touch electrical equipment or wires unless you are working on them. Then make sure that you cannot get a shock. Consider all wires as live." The circular concludes with an appropriate motto for workers: " I will always work safely and not be the cause of injury to either my mates or myself." Both publications are obtainable from the National Safety First Association, 119, Victoria Street, London, S.W.1.

Free Wiring.

The more progressive electricity supply undertakings are gradually getting down to the basis of being able to offer a supply of current without involving the prospective consumer in any heavy preliminary expenditure for wiring and fitting his premises. If only a satisfactory scheme can be evolved and generally applied, whereby tenants could be approached on the principle of no charge until your house is wired and current actually available and then you only pay according to consumption, there would be many thousands of additional converts to domestic electrical service, so that the scheme is well worth a little preliminary difficulty and trial in the evolution to make it satisfactory to all parties. Such a suggestion has been submitted by the Sheffield Electricity Committee, and has for its object the provision of working-class houses with electricity at much less cost than under existing conditions.

Broadly speaking, the scheme provides for all wiring and fitting, including the first supply of lamps to be put in at the cost of the department, and for current to be subsequently supplied through slot meters at a unit price, which will not only cover the cost of current but also rent of meter and interest on sinking fund and cost of installation. The manager of the department, Mr. S. E. Fedden, reports that a scheme which has been in operation for the past twelve months has been unsuccessful, principally because the rental (a shilling a quarter for each light) is too high and is to be paid in perpetuity. He is of the opinion that a rental of 6d. per quarter per light would return the cost of installation in ten years, and, if this price were fixed for rental and an alternative price for purchase by instalments over a period of years were offered, many of the objections would be overcome.

Electricity Failures.

Apropos electricity supply breakdowns, which, by the by, are still being reported all too frequently, a rather humorous suggestion was made in the course of an inquiry at the Dover Electricity Works. It seems that on the occasion of the first failure the lighting of the power station was itself seriously affected, adding to the difficulties with which the staff had to cope. As a result, some Aladdin lamps have been requisitioned for use in similar emergencies in the future. It was also proposed to suggest to the gas company's manager that electric light should be installed in the gasworks, and that, as a *quid pro quo* and stand-by in case of breakdown, the Council should instal *gas in the electricity works.* A humorous admission of weakness on the part of the authorities concerned, but, nevertheless, on a par with the emergency lighting points in most theatres and cinemas, where gas is installed as a stand-by in case of the sudden failure of electricity. Gas-lighting for an electric power station is bringing the trouble home to roost with a vengeance.

Electrical Christmas Gifts.

I have already referred to this subject more than once in the columns of Current Topics, and to the enterprise of Mr. J. W. Beauchamp, of the E.D.A., in pushing the electrical Christmas gifts idea throughout the trade. There is no doubt that the Christmas shopping season presents an unequalled opportunity for the enterprising dealer in electrical goods to add to his profits, and our friends the G.E.C. are doing their utmost to carry it out by developing a demand for the various novel and useful " Magnet " electrical appliances which are now available, and which immediately suggest themselves in this direction. But special trade of this description calls for special measures to attract it.

The electrical industry has been slow to take advantage of this opportunity, and it is difficult to understand why. In many other industries the Christmas season is regarded as the great trading opportunity of the year, and experience proves that this is so. But, remember, they organise for it. The problem of the Christmas gift is one which affects us all, each year. Every Christmas it is " the same old thing," and there is always the desire for something different. It is safe, therefore, to assume that any novel and useful suggestions will find a quick response with practical results. I firmly believe that by proper suggestion and by combination of effort the electrical gift can be made to solve this problem.

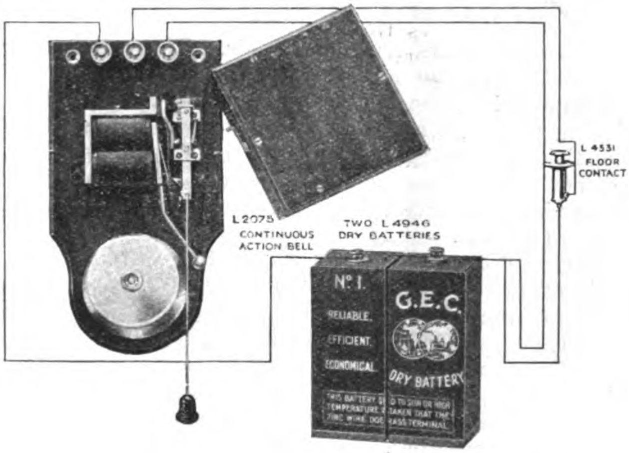
What is required is that we shall all join one great concerted effort to spread the electrical Christmas gift idea. Let us ourselves give electrical gifts. Let us talk of the electrical gift. Let us display electrical gifts in our windows and showrooms. Let us lose no single opportunity of driving the message home to the people. Fashion, once set, tends to grow! Once the electrical gift idea has got a grip, the public will take it up. It does not require much stretch of imagination to appreciate what would be the effect of innumerable electrical Christmas gift windows all over the country, each displaying electrical Christmas gifts; how attention can be arrested by judicious circularising, and how combination of effort will help to set this idea in motion. Every electrical dealer should seize this opportunity.

In this there is a vast field for a new and seasonal business for enterprising and up-to-date dealers, and I believe that by propaganda of an educational nature a big response will be obtained. I am, therefore, more than pleased to hear that, in order to stimulate public interest in the electrical Christmas gift idea, the General Electric Company, Ltd., has prepared extensive publicity plans, by means of which they hope to promote an interest which will reflect to the advantage of the dealers who co-operate with them in this great campaign. A selection of leaflets, folders, and other printed matter has been prepared, and is available (with over-printed name and address) for the use of traders who will associate themselves with the "Magnet" Christmas gift campaign. Attractive window display material, complete window-dressing schemes, seasonal price tickets, etc., all suggesting the electrical Christmas gift idea, are included in the G.E.C. offer of assistance, and will be supplied free of charge to those who participate in this campaign, so I hope it will be cordially supported by my trade readers. In the long run, enterprise of this description is bound to react to the general advantage of the trade, whether initiated by the G.E.C. or any other wholesale house.

Elektron.

THE G.E.C. BANDIT ALARM SYSTEM.

Bank robberies and "hold-ups" in post offices and shops have figured prominently in the newspapers during the past few months. In order to afford protection against such attacks, the Bandit Alarm System has been devised by the General Electric Co., Ltd. It consists of a standard continuous-action electric bell operated by a battery consisting of dry cells, the bell being set in action in any emergency by the employee depressing a floor contact fixed in some inconspicuous but strategic position. Experience has shown that a criminal in the performance of his craft is in a highly nervous condition, and when suddenly disturbed, as by the shrill notes of a powerful bell at the psychological moment, will seldom fail to make off with all possible speed.



The outfit, which is illustrated herewith, should therefore prove very effective. It is simple and easy to instal, and we look on it as a line which an enterprising contractor could make extremely lucrative. Incidentally, the system has met with the approval of experts well qualified to pass an opinion on such matters, for 500 outfits have recently been ordered by one of the leading British banking houses.

There are new fashions every day, but old-fashioned honesty always is in style.

TELEPHONY.*

Being solutions to the questions set in Grade I. examination of Telephony held by the City and Guilds of London Institute on May 1, 1924.

Q.—In what points in telephone exchanges are fuses used? What differences in fuse design are to be found in an exchange? Why is it that the fuses used at different points are of different designs?

A.—The points at which fuses are used in telephone exchanges are: Where the main power leads enter the building; in the leads between the charging generator and the battery; between the battery and the fuse panel; on the fuse panel in the speaking and signalling circuits, in the meter circuits, and the night-bell circuits; and on the line side of the main distribution frame.

The fuses used are metal-capped fibre-cased or glass-tube type and the "alarm" type. In circuits carrying a heavy current, as in the main power leads, the fuse should be of substantial design and of the protected type. The rating of the fuse wire varies according to the maximum current permissible in the circuit with which the fuse is associated.

The function of a fuse is to reduce the risk of fire or damage to buildings or apparatus when faults occur. In addition, an "alarm" fuse apprises the attendant of a fault by ringing a bell, or by other means. The design of fuses differs according to the circuit in which they are to be used. Thus, fibre-cased fuses are employed in the main leads, in the generator leads, the battery leads, etc.; while "alarm" fuses are used in the circuits brought to the fuse panel One type of alarm fuse consists of a strip of micanite, $1\frac{3}{8}$ in. long and $\frac{3}{8}$ in. wide, bound at its two ends by thin copper, one end being turned up and carrying a spiral spring, on the bent end of which a glass bead is attached. The other end is clamped to the battery bus-bar, and carries a flat German silver spring. The fuse wire is soldered between the flat and wire springs and is in tension between the two. When the fuse melts, the flat spring comes into contact with the alarm bar, a lamp is lighted, and a bell in circuit with the alarm bar rings. The rating of the fuses mounted on the fuse panel is about $1\frac{1}{3}$ amperes, and of the fuses in subscribers' circuits about 3 amperes. The rating of the fuses in the main leads, the battery leads, etc., varies, of course, with the maximum current the particular circuit is designed to carry.

(To be continued.)

Evershed and Vignoles, Ltd., of Acton Lane Works, London, W.4, announce a 20 per cent. reduction in the price of their well-known "Ducter." Interested readers should write them at once for copies of catalogue 137 and price list J.

A catalogue of industrial sands has been issued by **Mr. A. L. Curtis**, of Westmoor Laboratory, Chatteris. It is a comprehensive pamphlet with illustrations of the quarries from which the various types of sand are obtained as well as details of the purposes to which they can be put, and it should therefore be of direct value to foundry engineers and sand users generally. Copies will willingly be sent on application, mentioning this notice.

---

* Consult *Questions and Solutions in Telegraphy and Telephony*, Grade I., by Few. Price 5s. 10d. post free from Electricity Office.

Practical Electrical Engineering Hints.

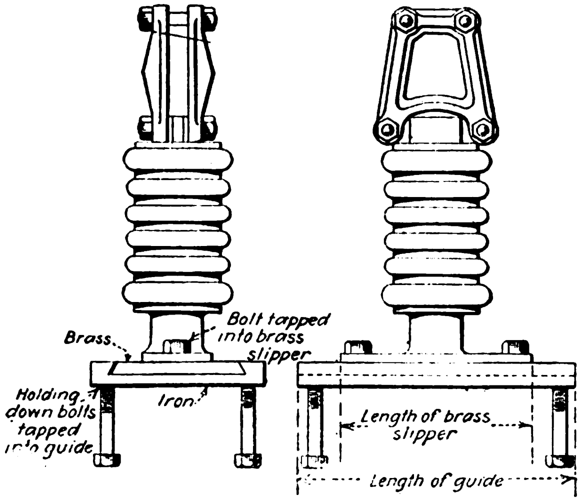
We cordially invite all our readers to contribute to this interesting and useful feature. All hints received will be given careful consideration and will be paid for at our usual rates.—THE EDITOR.

NO. 26.—HOW A SLIDING BASE PREVENTS THE BREAKAGE OF INSULATORS.

In our central station a heavy bus-bar of some length and supported upon insulators was giving trouble, due to the tendency of the insulators to break.

Upon investigation it was found that this was due to the expansion of the copper when the circuit was heavily loaded. We did think of putting expansion joints in the bars, but, since these had to be of a flexible nature, it was difficult to design an efficient joint.

What we did do was to make a sliding base as shown in the sketch. This consists of two separate parts—one the brass slipper, which is attached to the insulator, and the other the guide, in which the slipper moves. The guide is of cast-iron machined, as shown. From the sketch it will be seen that no strain is placed upon the insulator.—R. H. N. LOCKYER.

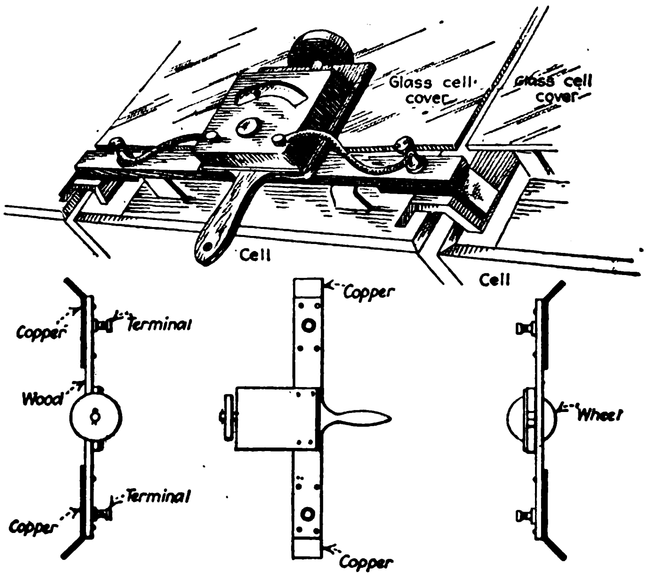

Bolt tapped into brass slipper
Brass
Holding down bolts tapped into guide
Iron
Length of brass slipper
Length of guide

NO. 27.—HOW VOLTAGE READINGS OF A LARGE BATTERY CAN BE EASILY TAKEN BY ONE MAN.

Taking voltage usually requires two men—one to carry the voltmeter and take the readings, while the other marks them down. In order that voltage readings may be taken without trouble on the cells of a large battery, a rolling holder with connecting contacts has been made by the writer. This device eliminates carrying the voltmeter on the arm, and allows the man taking the readings to record them.

The meter rests upon a piece of $\frac{1}{2}$-in. board, as shown in the sketch; the square part accommodates a voltmeter, while on one edge a small spur is left to act as an axle for a wooden or hard rubber wheel, 4 in. in diameter. On the opposite edge to the axle a handle is formed. Handle, axle and meter platform are all one piece of wood. Small beading is tacked round the edge of the meter board to prevent the meter from falling off. To the bottom of this board is fastened a strip of wood, 1 in. by 2 in. in size, cut long enough to span the outside of the cell which has the largest spread.

Two pieces of copper or brass sheeting, 1 in. by 6 in., are mounted on each side of the stick so that about 2 in. projects beyond the ends. These pieces are fastened on by the studs of two binding posts, which are mounted on the opposite side of the strip. These binding posts are mounted far enough from the end of the stick to ensure that their studs on the opposite side will not come in contact with the lead cell connectors. The ends of the metal strips are bent downwards at an angle of 45 deg.



In operation the meter is laid on the boardband, the leads are fastened on the binding posts. Before taking readings the plate-glass cell covers should be moved back from the edge of the cells to expose at least an inch of the connectors. The contacts are placed on the edge of the lead connectors, while the wheel bears on the centre of the plate-glass cell cover. When it is desired to move the meter to the next cell the handle is lifted with one hand until the contact pieces are clear, and then it is rolled over the plate-glass cover to the next cell.

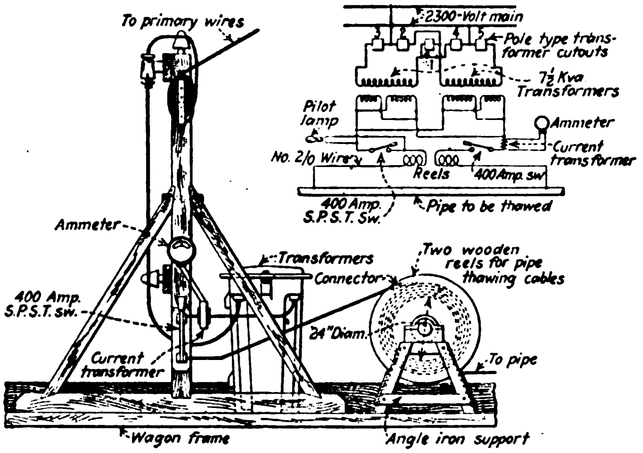
This small conveyor, when not in use, can be hung in the battery room if a hole is drilled in the handle.—JOHN E. MCCARTHY.

NO. 28.—HOW PORTABLE PIPE-THAWING APPARATUS LIMITS CURRENTS.

By winding the two secondary leads of an electric pipe-thawing outfit in opposite directions on reels having a common steel shaft it is possible to obtain an adjustable reactance for limiting the current employed.

Portable apparatus involving this feature consists essentially of a wooden frame for supporting leads attached to the supply, two $7\frac{1}{2}$-kw. transformers and two reels having a steel shaft. The details of construction are indicated in the sketch.

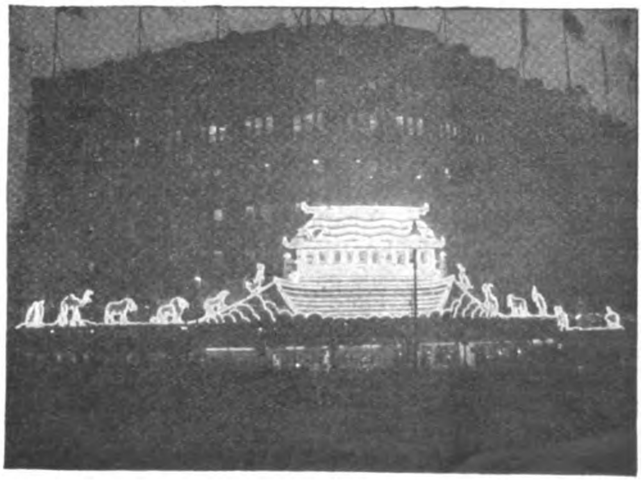
When plugs 2, 3, 4 and 5 are inserted, the primaries of the transformers are connected in parallel, and 110 volts is impressed across the secondary terminals. If plugs 1, 3 and 5 are inserted, the transformers are connected in series, and 55 volts are impressed across the secondary winding.



In the secondary circuit are a pilot lamp and an ammeter, the former indicating whether the circuit is closed and the latter guarding against overloading the transformers. For a short job all the wire is unreeled, but for a long job about eight turns are left on the reels to limit the current.—J. N. LIGHTBODY.

"THE ANIMALS WENT IN TWO BY TWO."

Annexed is an illustration of a remarkable sign situated on the exterior of Messrs. Lewis's Emporium at Liverpool. The sign is said to be the longest in England, being 380 ft. long and 50 ft. high. It represents Noah's Ark, and animals are seen entering the Ark "two by two." The work of erection was carried out by Messrs. Lewis's own electricians, and it involved the use of 7,500 Osram lamps, as well as over 10 miles of wire. It has proved an immense attraction to the kiddies.



CALENDARS, DIARIES, ETC.

The very handsome almanac which has been issued by Callender's Cable and Construction Co., Ltd., is a reproduction in colour of an original painting by Mr. W. B. Lasham. The title is "Erith Reach," and Messrs. Callender's works are visible in the background, but they are in no sense obtrusive, and this most certainly enhances the artistic effect of what is in truth a charming piece of colour work, and as such an ornament to any room or office.

The useful pocket diary and season ticket case which has been issued by Mr. Charles Selz, the silk lampshade manufacturer, of 83, George Street, London, W.1, is certain to be appreciated by all recipients. The section explaining the commercial phrases in everyday use is a decided novelty, and the Morse code will have the approval of wireless enthusiasts.

The Simplex pocket diary has made its appearance as usual, and we are certain that the neat squared paper on which the dates are printed will be appreciated by all engineering readers, while the text with regard to the Simplex specialities and technical data in general is thoroughly useful and up to date.

AN ELEMENTARY INVESTIGATION OF THE ENERGY OF A MAGNETIC FIELD.

By S. A. SWANN, B.Sc. (Eng.).

(Continued from page 656.)

It is interesting to estimate from the above expression what is the maximum amount of energy that may be stored in a non-magnetic substance.

We have $$\frac{1}{\mu}\,\frac{B^2}{8\pi} = \mu\,\frac{H^2}{8\pi} \text{ ergs per cubic cm.}$$
$$= \frac{H^2}{8\pi} \text{ ergs per cubic cm.}$$

for a non-magnetic substance.

The maximum value of H that may be obtained by normal means is about 24,000 lines per square cm.

Hence $$\frac{H^2_{max}}{8\pi} = \frac{(24000)^2}{8\pi}$$
$$= 23 \times 10^6 \text{ ergs per cubic cm.}$$
$$= 28 \text{ ft.-lbs. per cubic inch.}$$

The energy formula may be obtained in alternative forms which are occasionally more useful.

We have back $EMF = L\,\frac{di}{dt}$ volts

where L = coefficient of self induction of the magnetising coil.

Hence power absorbed = back EMF × current
$$= Li\,\frac{di}{dt}$$

∴ Energy required to build up the field
$$= \int_0^t Li\,\frac{di}{dt}\,dt \text{ watt-secs.}$$
$$= L\int_0^t i\,di \text{ watt-secs.}$$
$$= \tfrac{1}{2}Li^2 \text{ watt-secs.} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

assuming the inductance and therefore the permeability of the material constant. This proof is in terms of the electric and not the magnetic circuit, and hence is applicable whether the field be uniform or otherwise.

Again, we have

$$\text{Stored energy} = \frac{l}{4\pi A\mu} \times \frac{\phi^2}{2} \times 10^{-7} \text{ watt-secs.}$$

$$= \phi \times \frac{l}{A\mu} \times \frac{\phi}{8\pi} \times 10^{-7} \text{ watt-secs.}$$

$$= \frac{4\pi}{10} Ni \times \frac{\phi}{8\pi} \times 10^{-7} \text{ watt-secs.}$$

$$= \tfrac{1}{2} \times (\text{ampere-turns}) \times (\text{flux}) \times 10^{-8} \text{ watt-secs.} \qquad (3)$$

It will be interesting to examine the case of the field circuits of an electric generator. No load conditions are assumed, since when a machine is on load the main field is invariably distorted and generally weakened as well by the field due to the armature currents.

Example—

Flux per pole $= 7.8 \times 10^6$ lines
No. of poles $= 6$
Ampere-turns per pole $= 5{,}210$
$\therefore$ Energy of field per pole

$$= \tfrac{1}{2} \times 5210 \times 7.8 \times 10^6 \times 10^{-8} \text{ watt-secs.}$$
$$= 52.1 \times 3.9 \text{ joules.}$$
$$= 52.1 \times 3.9 \times \frac{550}{746} \text{ ft.-lb.}$$
$$= 150 \text{ ft.-lb.}$$

$\therefore$ Total energy of field system

$$= 150 \times 6.$$
$$= 900 \text{ ft.-lb.}$$

This would have to be dissipated as heat and light if the circuit were opened, so that we are now in a better position to appreciate the significance of the violent spark that would occur.

The induced pressure rise tending to delay the fall of current may easily be estimated as follows:—

The induced *EMF* at any instant of time between the separating of the switch contacts and the extinction of the subsequent arc is given by

$$e = -L\frac{di}{dt}$$

where $\frac{di}{dt}$ = rate of decay of current at the instant considered,

and L = the inductance of the electric circuit corresponding to the permeabilities of the different parts of the magnetic circuit, at that instant.

If we assume L constant, we may write:

Average induced $EMF = L \times$ (average rate of change of current)

Assume field current = 5.2 amps.

$\therefore$ Turns per pole = 1,000.

If the arc exists for $\frac{1}{5}$th sec. we have—

$$\text{Average rate of fall of current} = \frac{5.2}{\frac{1}{5}}$$
$$= 26 \text{ amps. per sec.}$$

Again, L = (flux produced when 1 amp. flows through the winding) $\times$ (turns per pole) $\times 10^{-3}$

$$= \frac{7.8 \times 10^6}{5.2} \times 1000 \times 10^{-8} \text{ henrys}$$
$$= 15 \text{ henrys.}$$

Hence average induced *EMF*

$$= 15 \times 26$$
$$= 390 \text{ volts per pole.}$$

$\therefore$ Total induced *EMF* in the field winding

$$= 390 \times 6$$
$$= 2340 \text{ volts.}$$

(*To be continued.*)

Reviews of Books, &c.

[Books noticed in this column will be sent from ELECTRICITY *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

P.O. TECHNICAL INSTRUCTION V.: THE WHEATSTONE TELEGRAPH SYSTEM. 88 pp., 92 illus. (H.M. Stationery Office, 3s. 11d. post free.)—All readers of ELECTRICITY who are interested in telegraphy, and we believe that we number quite a fair proportion of the telegraph engineers of the Kingdom in that category, will give a hearty welcome to this new publication. It contains a large number of splendid illustrations and diagrams of the latest type of Wheatstone telegraph instruments as used in the British postal service, as well as a general description of all parts thereof, including the perforators, transmitters (both weight-driven and motor-driven), receivers, the connection of the apparatus and the various methods of working, including simplex and duplex, as well as a chapter on speed tests, and details of the vibrating relays, such as the Gulstad, and its adjustment. Finally, there is a magnificent series of working diagrams which will render the pamphlet of great additional value to every telegraph student and worker. We can therefore most cordially recommend it to our telegraph readers as a work which should be purchased and studied carefully without delay.

ELECTRICITY METER PRACTICE. By H. G. Solomon. 189 pp., 58 figs. (Griffin. 7s. 6d. net.)

In this volume the author gives a simple but reliable treatment of the principles of operation and the behaviour and testing of direct and alternating current meters, with special reference to the service and recalibration tests of meters of the motor type. That such a book will be useful to meter attendants, junior electrical engineers, and students goes without saying. The first 114 pages of the book are devoted to a description of the general principles of D.C. motor meters, electrolytic, oscillating, and clock meters, single phase and polyphase induction meters, and tariff meters. Descriptions of particular makes of meter and information regarding mechanical features are given only where essential to make clear the principle of operation and the characteristics of the meter; complete information on these points is, of course, given in the author's larger work, of which, we are pleased to learn, a second edition is being prepared. In the book here reviewed the information given is restricted mainly to a clear statement of what is measured by each type of meter, and what precautions and adjustments are required to secure reliable and accurate operation. The remainder of the volume deals with meter testing, the procedure to be followed in testing each type being explained clearly, and a number of useful connection diagrams being included in the appendix. The calculations required in the various tests are explained, and altogether this book is a most satisfactory combination of theory and practice, which we have no hesitation in recommending to the classes of readers for whom it is intended.

SPON'S ELECTRICAL POCKET-BOOK. By W. H. Molesworth. Second edition; 488 pp., 325 figs. Spon. 7s. 6d. net.)

We have pleasure in bringing to the notice of our readers the second edition of this useful pocket-book, in which a number of additions have been made, other sections being revised where necessary. The latest Government regulations (El. C. 38 and 39) regarding overhead transmission lines are included, also a useful abstract of the new wiring rules of the I.E.E. Account has been taken of the new basis of specifying wires by inch measurements, but the author has wisely retained the S.W.G. system, which will undoubtedly remain in general use for many years to come. The value of such a volume as this can only be appreciated after a long period of use, but we can honestly say that we have frequently found the book of great assistance, and it is one which should be on the shelves of every electrical engineer. The book is particularly useful in regard to its standard mathematical tables and formulæ the notes on electric circuit calculations and properties of electrical conductors; the general principles and constants of electrical conductors, D.C. and A.C.; methods of testing cables; notes on secondary batteries, electro-chemical work and illumination. The information given regarding electric traction is particularly valuable; it covers the general calculations required in traction problems, deals specifically with tramways and railways, and occupies about one-quarter of the total length of the book.

STUDIES IN TIDAL POWER. By Norman Davey. 255 pp., 56 figs., 66 charts. (Constable. 32s. net.)

The appearance of this volume is particularly welcome, coinciding as it does with the revival of interest in the Severn tidal power scheme in this country and with the construction of the Aber Vrac'h scheme in France. The author first reviews critically the different methods by which it has been proposed to harness tidal power, and he is so definitely of the opinion that basin systems alone are of practical value that he deals only with these in the remainder of the book. It would appear, however, from a number of interesting articles which have lately appeared in the technical Press, that the use of compressed air as a link between tidal power and electric power offers many advantages, and we hope that in a later edition of this work the author will investigate more fully the possibilities of hydro-compressors. The fact remains, however, that the French installation, which is the only large tidal power scheme yet under construction, is to work on the basin system, and the same general principle is applied in our own ambitious Severn barrage project. Mr. Davey deals most carefully and clearly with the theory of various basin systems, and shows in what important respects and to what extent practice departs from theory in this connection. He describes also tidal power plants as so far developed, and he has the courage to make estimates of costs in typical cases, these estimates being set out in such manner that they can easily be adjusted to suit the circumstances of individual cases. The author is also to be complimented upon the vast amount of labour he has devoted to preparing a tidal power survey for the British Isles. From the particulars derived in this way it seems that we might obtain somewhere about two, three, or even four million horse-power by the development of 70 or 80 tidal power schemes round our coasts. This would represent an important contribution to the solution of our coal problem, but, on the other hand, the comparatively small total and the very large capital expenditure which would evidently be required to develop it show clearly that tidal power does not offer the complete and easy path to prosperity that some enthusiasts would have us believe. In preparing this excellent work, Mr. Davey has rendered important service to the engineering community, and we trust that his reward will be commensurate with the time and trouble he has expended so lavishly.

APPLIED ELASTICITY. By J. Prescott, M.A., D.Sc. 666 pp. (9 in. by 5½ in.), 84 illustrations. (Longmans, 25s. net.)—This treatise on the mathematical theory of elasticity is an attempt to present the subject from the point of view of the engineer rather than from that of the mathematician, only those problems being dealt with which have some connection with engineering construction.

The fundamental equations concerning stress and strain and the elastic constants in an isotropic material are followed by a short chapter showing the empirical nature of the data upon which the theoretical investigations rest, and which must not be lost sight of when applying the theory to practice. The serious work of the book then begins, and covers stresses in beams of all types; columns, including lateral loading; the St. Venant or general problem of torsion; elastic vibrations, tensional, torsional and transverse; springs of various forms, including piston rings; curved beams, and cylinders. More difficult problems are then discussed, such as the stretching of thin plates, including the effect of holes therein; stresses in flat plates, this also covering the effect of stretching of the neutral surface; flat plates under buckling stresses; the vibrations of rotating discs; and the stresses in elastic bodies in contact.

Many of the problems investigated are not usually found even in advanced books on the strength of materials, and are of considerable interest. The treatment is generally clear, but the work is necessarily heavily mathematical, and only those whose mathematical equipment is fresh and of the best is likely to follow it. The book is well printed and produced, and all important equations are numbered, so that reference is simplified.

From the engineering point of view it is, perhaps, unfortunate that common engineering terms have not been adopted in place of the mathematical language in many places, and that there is so little mention of practical applications of the results deduced. The opening chapters, covering the laws of principal stresses, appear to be too briefly treated for the engineering reader, and are better explained in the usual engineering text-books on the subject. Diagrams could have been more freely employed for explanation and illustration of results, and are generally preferred by engineers to mathematical expressions.

Various Items.

Appointment.—Dr. W. R. Goode Adams, Ph.D., B.Sc., etc., has been appointed an assistant lecturer and demonstrator to Faraday House Electrical Engineering College.

Donaghadee (Co. Down).—At a recent meeting of the Urban Council it was decided to ask for the extension for another year of the Donaghadee Electricity Order, 1911.

Junior Inst. of Engineers.—Dr. Alexander Russell, M.A., D.Sc., LL.D., F.R.S., M.I.E.E., has been elected President for the session 1924-25. His inaugural address will be delivered at the Royal Society of Arts on Wednesday, January 7, 1925.

Exhibition.—The next Public Works, Roads and Transport Congress and Exhibition will be held at the Royal Agricultural Hall, London, N., from November 19 to November 26, 1925. Particulars may be obtained from the Exhibition Offices, 13, Victoria St., London, S.W.1.

Prague Spring Fair.—The management of the Prague International Fair have decided to organise a wireless exhibition within the Prague Spring Fair, to be held from March 22 to 29, 1925, with a view to developing the wireless industry and broadcasting. The rules and regulations may be consulted at the D.O.T., 35, Old Queen St., London, S.W.1 (Room 53), by firms interested.

Quotations Wanted.—The New South Wales Govt. Rys. and Tys. at Sydney are calling for tenders for two lighting storage batteries.——The same Government also invite tenders for two motor-driven self-cleaning water screens, and for two motor-driven air compressors. Further particulars on application to the D.O.T., 35, Old Queen St., S.W.1

Tenders Accepted.—The Great Western Ry. Co. have accepted the tender of the Edison Swan Electric Co., Ltd., for gasfilled lamps.——The Admiralty have accepted the tender of the G.E. Co. for 107,000 Osram Squirrel-cage traction type lamps and 51,000 Osram gasfilled lamps. The G.W. Ry. Co. have also accepted their tender for a 12 months' supply of Osram gasfilled lamps.

The Admiralty have accepted the tender of the Edison Swan Electric Co., Ltd., for the supply of carbon filament lamps.

Meetings.—The Junior Inst. of Engineers will meet on Friday, 19th inst. Lecture, "Aircraft in Japan," by Col. the Master of Sempill. Slides. And on Friday, Jan. 2. Lecturette, "Modern Flour-milling Machinery," by W. Ringrose. Slides. Both at 39, Victoria St., at 7.30 p.m.

c.s. "**Faraday**."—Messrs. Siemens Bros and Co.'s c.s. *Faraday* left the company's works at Woolwich last Saturday afternoon loaded with 1,500 miles of submarine cable to be laid for the new Italian Cable Co. between Cape Verde Islands and the Island of Fernando Noronha, a small island off the coast of Brazil. Messrs. Siemens are, we understand, now actively engaged in the manufacture of a further 1,700 miles of cable to form the continuation of this company's system from Fernando Noronha south to Rio de Janeiro

Dance.—The newly formed London and District Section of the Institution of the Rubber Industry held their first dance at the Wharncliffe Rooms on Friday, 12th inst. Over 200 members and their friends were present, including Sir Stanley Bois (President of the Institution), Sir Henry Wickham, Mr. H. Eric Miller (Chairman of the Rubber Growers' Association), Mr. D. F. L. Zorn (Chairman of the Council of the Institution of the Rubber Industry), Mr. J. H. C. Brooking (who acted as M.C.), Mr. Herbert Rogers (Treasurer), Mr. B. D. Porritt, Dr. T. J. Drakeley, Mr. Herbert Standring, and many others. This dance was undoubtedly more successful than any other similar function held by the Institution, and the Committee will shortly be considering the advisability of holding another in the New Year.

Saws for Cutting Mica in Commutators.—We are in receipt of a sample saw blade for cutting mica in commutators, manufactured by Fry's (London), Ltd., 46, Upper Thames Street, London, E.C.4. The necessity for an efficient saw blade for this work has long been felt. We have tried the sample submitted to us and have found it satisfactory in every way. The teeth are straight and not offset alternately, this arrangement minimising to a large degree the slipping and scraping of the commutator which usually accompanies an attempt to use ordinary hack saw blades for undercutting mica.

From **Millerphones**, of 79, Holborn Viaduct House, E.C.1, we have received a circular describing the instruments which are supplied by the company for departmental intercommunication, and for which they are prepared to estimate for installation and maintenance at a very modest annual figure. The list, therefore, should be of interest to large stores, factories, mills, etc., where prompt departmental intercommunication is an essential point.

Trade Notes.

From the **D.P. Battery Co.** we have received an illustrated circular describing the Railodok Garage at Wembley, as well as illustrating various sections of the plant which proved so successful in practical use. The circular will appeal to all who are interested in these very useful small passenger and goods carrying vehicles, in which the D.P. Battery proved such a wonderful success.

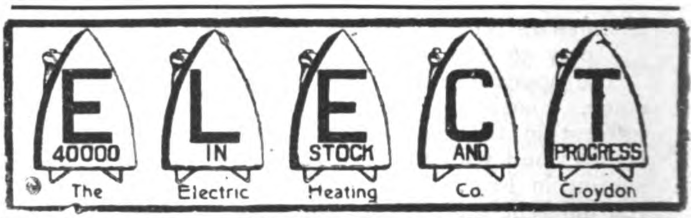
Leaflet 13/27, just issued by **Messrs. Bastian and Allan**, of 58, Haymarket, London, S.W.1, gives illustrations and full particulars of the latest type of Bastian Storage Geysers, which are apparently giving considerable satisfaction to users in all parts of the kingdom. The list should certainly prove of interest to electrical installation contractors who may be asked to quote for hot water heating in private houses, mansions, hotels, etc.

A monthly price-list for December has just been issued by the **Siemens and English Electric Lamp Co., Ltd.**, of 38, Upper Thames Street, London, E.C.4. As usual, it contains prices and illustrations of apparatus of direct interest to all installation contractors and retail dealers in electrical supplies, and any reader who has not yet received a copy should apply for it at once on regular trade paper .

More circulars about the B.T.H. Headphones, Mazda Lamps and Headphones leaflets have just been issued by the **B.T.H. Co., Ltd.**, advertising department at Crown House, Aldwych, London, W.C.2, and should appeal to all traders and retail dealers in these quick selling lines. Application for full details as to the assistance rendered to the trade should, therefore, be sent along to the advertising department without delay.

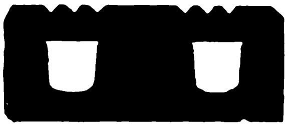
A splendid 84-pp. 4to catalogue has come to hand from **Messrs. W. T. Glover and Co., Ltd.**, of Trafford Park, Manchester. It deals directly with the rubber section of the company's manufactures, including cab-tyre sheathed cables, and is called List No. 20. As such it will, of course, appeal to all installation contractors and dealers in electrical supplies, and Messrs. Glover will be pleased to forward a copy to any such reader on receipt of proper trade application.

Personal.—Messrs. George Ellison, of Perry Barr, Birmingham, have appointed Lt.-Colonel F. W. Foster, M.C., late of Messrs. The English Electric Co., Ltd., as manager of their branch office at Manchester.



ARMATURE REPAIRS
MARRYAT & PLACE.
28, HATTON GARDEN.
LONDON E.C.1.

CASING AND CAPPING.



BLOCKS, CLEATS,
BOARDS FOR SWITCHES
in stock and made to any design.
ACCUMULATOR CASES
and BATTERY BOXES
Made to Order.
J. F. & G. HARRIS, Ltd.,
Timber Merchants and Moulding Manufacturers,
SAWING, PLANING, MOULDING & GENERAL WOODWORKING MILLS
58g, WILSON ST., FINSBURY, LONDON, E.C.
Telephone No: 1168 London Wall Please write for Illustrated Price List.

A POPULAR SCIENTIFIC WEEKLY JOURNAL
ELECTRICITY
PRACTICAL TRADE JOURNAL

DECEMBER 26, 1924.

CONTENTS.

	PAGE
Protective Apparatus for Electrical Machinery	707
The King Variable Speed A.C. Motor	708
The Institution Wiring Rules	709
Speeding Up the Telegraphs: A Forecast of the New Telegraphy	710
Current Topics	713
Telephony	715
Electrical Engineering.—Final Grade	716
Our Wireless Corner	719
Illuminating Engineering	720
Questions and Answers by Practical Men	720
Reviews of Books	721
Trade Notes	722
Various Items	722

PROTECTIVE APPARATUS FOR ELECTRICAL MACHINERY.

(*Continued from page* 645.)

FAULTS WITH GROUP (A) GENERATORS.

Faults to Earth.—Considering first the class of generators denoted by group (*A*), the conductors of these machines are in electrical contact with the busbars, and, therefore, are directly connected to all feeders and transformers on the distribution system. If, at any point on the network or in the windings of any of the generators themselves, a leakage develops between one of the circuits and earth, then the pressure between the individual phases and earth is disturbed, and if the neutral point of the system be earthed by connecting resistances between the neutral point of one or more of the generators and earth (as in Fig. 1), all fault currents to earth will pass through these resistances. Thus, if one of the windings in a three-phase generator breaks down to earth, then the fault current returns through the neutral point of the generator via the resistance inserted to control the current component of the fault.

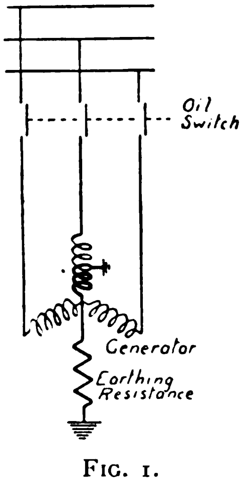


FIG. 1.

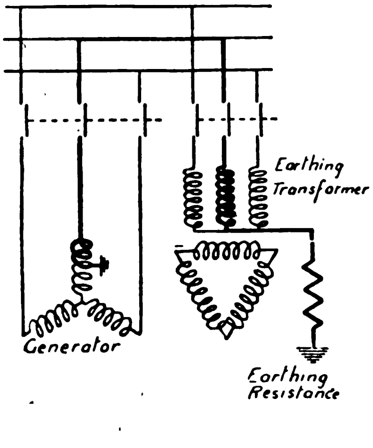


FIG. 2.

Under these conditions the time component begins at the moment of breakdown, and is not completed until the value of the flux from the rotor has fallen low enough to prevent any further extension of the damage already done. The failure of the field-breaking switch under these conditions would certainly result in somewhat severe damage, possibly to the core of the stator. A rearrangement of the protective gear will not only shorten the time component, but will do away with the necessity of having a field-breaking switch for that particular class of fault.

The earthing resistance, instead of being connected between the neutral point of the generator and earth, should be connected to another part of the system. This alteration is best brought about, as shown in Fig. 2, by having a special transformer, with the star point of the primary windings earthed through a resistance of suitable value, and the secondary windings connected in delta.

This arrangement has the advantage of bringing the oil switch into the circuit which must be traversed by any fault current, due to one of the generator windings breaking down to earth. The time component of the fault would then terminate when the oil switch broke the circuit.

The instantaneous reduction of the flux in the rotor, although necessary for clearing faults of a type other than that being dealt with at the moment, in no way helps to limit the damage, as the time component of the fault has already been completed.

Faults Between Phases.—The relatively low value of the impedance of a circuit between phases allows heavy currents to flow under these conditions, and, as the whole circuit is in constant use, it is not feasible to increase this impedance. The current component of the fault will be heavy, as it will be influenced by the machine design, together with any automatic voltage regulator connected to this machine. It is, therefore, the time component of the fault that offers the best opportunities of limiting the damage, and this is best brought about by the instantaneous isolation and de-excitation of the faulty generator.

The differential circulating current protection, operated from current transformers of appropriate design, is the most suitable form of protection for the immediate isolation of faulty plant.

Failure of D.C. Supply.—The failure of the direct current to the exciting circuit of a generator might be the result of severe damage in the rotor. It is, of course, advisable to have a means whereby a machine is automatically disconnected from the system. A reverse current relay in one of the phases can be suitably connected to operate at that power factor, which would result if the generator were magnetised from the main bus-bars instead of from the direct current supply to the rotor.

FAULTS WITH GROUP (B) GENERATORS.

In this group the usual arrangement consists of a generator designed to deliver current at any suitable pressure to the primary side of the transformer, and the secondary windings of the transformer are connected to the main bus-bars through an oil switch.

The transformer has to be considered as part of the generating unit, and must be included in the protection.

Units of this class are subject to all the failures mentioned in group (A), but, owing to the existence of two separate circuits (primary and secondary), certain advantages are apparent when the application of protection is considered. For faults between phases the differential circulating current protection is the most effective, and, as is the case with faults of this nature in generators under group (A), the current component will be of considerable magnitude, whilst the time component cannot be really effectively reduced.

The terminal voltage of the transformer is, as a rule, too high to consider the use of a special transformer for earthing the neutral of the system, and this results in the use of the generator transformers themselves as earthing transformers.

It will, therefore, be seen that, in the event of any portion of the extra high tension windings breaking down to earth, the opening of the main oil switch would not break the fault current, as would be the case with earth faults on stators in group (A), but the generator would continue to function as such until the operation of the field breaking switch reduced the current component to that value which would enable the arc to be finally quenched by the oil in the transformer.

The conditions under which a transformer has to operate are in many cases more severe than those met with in the operation of the modern stator, but with the advantage of the oil as an efficiently controlled cooling medium acting as a stable insulator, a transformer can be maintained in a reasonable state of dependability. With the stator, however, the depreciation, although gradual, is continuous, and for this reason there has been a greater need for the prevention of damage to stators than to transformers.

It is in dealing with faults to earth in the stators that the great advantage is to be found in the transformer-alternator combination. The fact that the primary side of this circuit has no physical connection with the secondary windings allows full use to be made of controlling the current component in the expression $D=CN$, as the value of the earthing resistance can be selected without consideration being given to the settings of relays or other points of the system.

Faults to Earth on Stator.—The relative decrease in the sensitiveness of circulating current differential protection, which corresponds to the increase in rating, operates severely against the possibility of having complete control of fault currents in the machines themselves.

Whilst all fault currents to earth return through the earth circuit, it is not possible to limit the current component without leaving a certain percentage of the windings unprotected as far as the time component is concerned—i.e., any resistance inserted between the neutral point of a generator and earth will limit the maximum fault current to earth, but will also so limit the minimum fault current that its value will be insufficient to operate the protective relays.

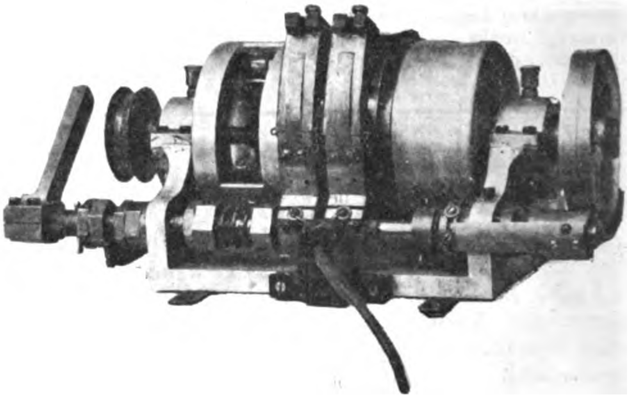
(*To be continued.*)

Nobody can do better than his best, but everybody can do better than he says is his best.

THE KING VARIABLE SPEED MOTOR.

Variable speed under definite control and over a wide range is frequently desired by the user of electric motors. Where direct current machines are concerned, speed control by varying the shunt field is both economical and convenient provided that the range of speeds desired is not too wide. For a speed variation of more than 2 or 3 to 1, however, shunt control alone is apt to result in unstable working, unless the machine be very specially designed; whilst the use of resistance in series with the armature is inefficient and results also in variations of speed as the load changes.

Again, one of the principal objections to the use of alternating current motors has been the difficulty of obtaining a wide range of speed variation, with reasonable efficiency, and, at the same time, steady operation at any desired speed within the available range.



These difficulties appear to be overcome, at any rate so far as motors of fractional horse-power are concerened, by the method invented and patented by P. T. King, of 15-17, Manchester Street, Luton, Beds.

Hitherto, the inventor has mainly confined himself to D.C. machines, but experiments have also been made with A.C. motors on the same principle, and we understand that the latter are likely to be finished at an early date.

As we are able to vouch from personal observation of its operation, the new type of motor will run at an infinitely variable speed between zero and maximum while exerting constant torque. There are no rheostat losses, for the simple and excellent reason that no rheostat is employed for speed regulation. On the other hand, a certain amount of power is dissipated as heat by the brakes mentioned below, and this would apparently prevent this method of control being applied to large motors with advantage. The new method has not yet been tested by the inventor on motors exceeding one-eighth horse power, but Mr. King is of the opinion that it could be applied to machines up to one horse-power with advantage over systems at present in use for variable speed driving. From our own observations we incline to the view that the method will be of principal utility in the case of fractional horse-power motors for which simple and perfectly flexible speed control is desired. The compactness and small weight of the King motor, and the fact that it requires no special clutch or controlling switchgear, make it ideal for many low power drives in which these considerations are particularly important. The inventor claims that the current consumption of the new machine is about 25 per cent. less than that in cases where speed variation is obtained through a clutch, and that the costs for maintenance and repairs are less than for other systems where clutches and resistance starters are employed.

As shown by the accompanying illustration, the distinctive feature of the invention lies in the mounting of the field magnet and armature in a fixed cradle in such manner that both parts are free to rotate. The armature carries a driving pulley at one end and a brake drum at the other. The circular casing of the field magnet carries two insulated slip-rings which serve also as brake rings, the carbon brushes serving also as a double-pole switch and as brake blocks. The hand- or foot-controlled lever operates the two sets of brakes, easing the pressure on one brake drum whilst increasing that on the other.

To start the motor the lever is depressed about one inch; this brings the brushes into contact with the slip-rings on the field system, and the latter begins to rotate, the armature being held stationary by the pressure of the brake on its brake drum. Further movement of the control lever increases the pressure of the carbon brushes on the field slip-rings and thus exerts a braking torque on the field. At the same time the pressure on the armature brake drum is somewhat relieved, and the armature therefore begins to rotate. As the lever is depressed still further the armature braking is progressively reduced, the speed of rotation of the armature increases, and that of the field system decreases. Ultimately the field is held stationary and the armature runs freely at full speed. An infinite gradation of speed is thus provided for the load which is driven from the armature pulley. Should an overload be thrown on the machine for any reason the field system rotates against its brakes (the brushes), these being operated through springs which are set to give the desired overload protection. The motor is thus safeguarded against burning out through overload. There is also a spring which pulls the control lever to the " off " position when the (mechanical) pressure on the lever is released; the brushes which normally carry current into the machine then leave the slip-rings, thus acting as a double-pole switch. In the event of failure of supply one would naturally release the control lever, so that the motor appears to be protected against all contingencies.

With the armature and field brake blocks properly adjusted, the amount of slip upon either component, armature or field, is regulated to a nicety by the position of the operating lever, any condition being obtainable from field free and armature fixed to armature free and field fixed. With equal braking on field and armature, the two parts will rotate in opposite directions, each at half its maximum speed with regard to the frame. The relative magnetic speed between the field and armature, however, remains practically constant whatever the speed of each part with regard to the fixed cradle. The full back-e.m.f. of the armature is therefore maintained at all speeds of the latter, and this, it is claimed, results in much more economical running conditions than are possible with any system of rheostatic control. The torque of the motor is kept constant at all speeds of the driven device.

We look forward to receiving test data concerning this motor in due course, and in the meantime have much pleasure in commending it to the notice of our readers as an ingenious and useful equipment of excellent manufacture.

THE INSTITUTION WIRING RULES.

At the informal meeting of the I.E.E., held on Monday, December 15, Mr. F. Pooley was in the chair, when Mr. F. C. Raphael opened a discussion on "The New Wiring Regulations of the I.E.E." The general interest in the subject produced a crowded meeting, while a desire to meet objections to the regulations accounted for the presence of a number of members of the Wiring Rules Committee.

A discussion of considerable importance was maintained until a late hour, and the chairman expressed the possibility that another evening may be allocated to the subject later in the session, for several who intended to speak were unable to do so. On the other hand, a number present who had felt uneasy about the significance of the regulations were reassured, and found them not the oppressive conditions their earlier impressions had conceived. The objections in the main boiled down to very little indeed, and chiefly arose from a desire not to increase further the cost of installation; but it was shown that expert estimators calculate the increased costs of installations at very small percentages. The Regulations evidently had the goodwill of many bodies, including the E.C.A., and with minor corrections they had the support of most authorities.

Mr. Raphael, after reviewing the origin and intention of the Wiring Regulations, criticised many of their stipulations, but his chief concern seemed to be for the status of existing installations now in good life and service, but which do not conform to the new Regulations, and which obviously cannot be condemned. The discussion made it clear that the Regulations do not proscribe existing work, nor can they be enforced for future installations, but must be regarded as a standard specification for a first-class job according to the lights of 1924.

Mr. Ll. B. Atkinson said all rules must contain a large element of compromise, and no member of the committee would dispute that some of the rules could be amended; but he had no use for the school of thought which wished to be without rules and felt any installation should pass if it did its job. On the question of the earthing stipulations, that had caused so much uneasiness, was it fair to put up an installation in such a way that negligent or ignorant people could get a shock? In regard to using a lamp-holder as a place to attach portable apparatus, the idea is due to U.S.A. practice, where they have a large contact screw-holder attachment. Those who scoff at the idea of dangers should know that the committee had plenty of instances of trouble, and the objections to the proposed remedies were not worth the life of a single individual. It is the business of the Institution to tell people what is required to make a 1924 installation, and the adoption of the Regulations would make an end of the operations of those who were putting up installations without any knowledge, conscience or care.

Mr. W. R. Rawlings said the new Regulations wouldn't put up the cost by providing anything more than a standard installation should contain.

Messrs. J. J. Bacon, H. J. Cash, P. Davies, J. M. Donaldson, E. B. Hunter, H. Marryat, F. W. Purse, W. R. Rawlings, W. E. Rogers, K. A. Scott-

Moncrieff, L. G. Tate, W. E. Warrilow and H. T. Young also spoke.

Mr. Raphael, in conclusion, appealed for another rule that shall make it clear that installations existing before the date of publication of the Regulations shall not be declared unsafe.

SPEEDING UP THE TELEGRAPHS: A FORECAST OF THE NEW TELEGRAPHY.*

By Donald Murray, M.A., Member.

This paper, which is mainly a forecast of the probable form that the telegraph service will take in the course of the next twenty-five years—a form that is described as the "new telegraphy"—refers to the world-wide complaints about the unsatisfactory condition of the telegraph service and the need for improving it and speeding it up until it takes its proper place alongside the telephone.

It is agreed that these complaints are well founded, and the telegraph service is described as being dear, slow and inaccessible. Speeding up the telegraphs and bringing them into closer touch with the industrial and financial life of the world is put forward as a necessity of the future. We must type as well as talk. We must "teletype" as well as "teletalk."

It is pointed out that the telegraph has many important advantages over the telephone, especially for communicating over distances of more than 50 miles, and the present ailment of the telegraph is diagnosed as excessive circuit facilities and defective terminal facilities. That is to say, there are more circuits than are required for the traffic at present available, and not sufficient telegraph machinery, and the telegraph equipment is not arranged. like the telephone, so as to link up closely with the business life of the community. The telegraph is not, but should be, at every business-man's elbow, like the telephone.

The remedy is the creation of printing telegraph, or, more briefly, teletype exchanges, giving telegraph facilities similar to the telephone facilities we now enjoy. This will evidently be the result of certain developments now taking place in America, where both the Western Union and the Bell Telephone Companies are about to offer telegraph typewriter service to business men, that is to say, to subscribers. If this proves commercially profitable, it will inevitably lead to the establishment of teletype exchanges in all the American cities, and they will be linked up by trunk or long-distance telegraph lines. This will put business men all over the United States directly in touch with one another by printing telegraphy. In this way the new telegraphy will be born.

The paper foretells that, in the course of years, this new development will have a revolutionary effect on telegraph offices, which will become automatic switching exchanges, very like an automatic telephone exchange; and the telegraph operators, like the telephone girls, are doomed to disappear, and their places will be taken by a few telegraph engineers and mechanics wandering about in the deserted telegraph operating-rooms, looking after the telegraph switching apparatus.

Examples are given of the advantages that this new telegraphy will confer on the business community.

The machine that has made this new telegraphy possible is the start-stop telegraph printer—provided with a typewriter keyboard and requiring only momentary synchronism. It can therefore be readily switched from one circuit to another. It can work at from 40 to 80 words a minute over any distance from 100 feet to 5,000 miles, and any girl typist can use it. This is the business-man's printing telegraph—the Ford car of telegraphy.

A NEW CRABTREE SWITCH.

Messrs. Crabtree, the well-known switch specialists of Walsall, are now manufacturing a single base double-pole switch (supplied also as a combined switch socket) which embodies all the precepts of advanced design and construction. Naturally the advantages of a double-pole quick-make and break switch action compacted to the dimensions of a single tumbler switch base is obvious, especially when the cost compared with that of a coupled tumbler is considered, and the following details of the new "Crabtree" switch indicate that it is possible efficiently to control heavy currents by such a method and thus save the additional expense of a coupled switch. The features to which the makers direct special attention are:—

The patented arrangement of contacts and switch arm ensures maximum double-break on each pole.

All covers are fibre-lined.

Wiring is facilitated by the terminals being finished in bright copper for positive—black for negative.

The switch has been tested 2,000 volts to earth, 4,000 volts between poles.

It is of interest to record a recent test made by Faraday House, both upon a 5 amp. switch and also on switch socket combination, as follows:—

The switch was started on a 3 amp. load (250 volts), switching on and off, with a half amp. increase at each operation. A load of 61 amps. was borne before the switch finally broke down.

When the small size of the switch—2¼ in. base diameter—and its rated capacity are borne in mind, the full significance of such a drastic test will be realised.

Installation contractors and engineers who wish for further information about this new switch should write Messrs. Crabtree and ask for a copy of their new list, E.57.

Catalogue A, illustrating and describing the Harrington stoker, with suspended tile roof, has just been issued by the **Riley Stoker Co., Ltd.**, of Palace Chambers, Bridge St., London, S.W.1. It contains excellent descriptions of this stoker and its varied applications, and should therefore be of direct interest to all central-station engineers.

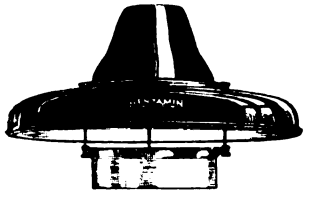
Leaflet 12/25-26 issued by **Messrs. Bastian and Allen**, of 58, Haymarket, London, S.W.1, gives illustrations and details of their new Rex imp stove and the Bastian electric storage geysers, together with prices of the former and testimonials of the satisfaction given by the latter. The circular should interest all installation contractors and dealers.

Lists 416 and 417 (3X), which have just been issued by the **Sun Electrical Co., Ltd.**, of 118, Charing Cross Road, London, W.C.2, deal respectively with wireless sets and parts and distribution fuse boards. The former is a very comprehensive catalogue of 84 pp., which will appeal to every wireless retailer, and should, therefore, be obtained at once by all who are dealers in these goods. The latter is of interest to installation contractors, who should write for it forthwith.

---

* Summary of paper read before the I.E.E.

Brilliant Light Without Glare
The BENJAMIN BIFLECTOR



The latest contribution to scientific illumination.

Ideal for Spinning Frames, Weaving Looms, Compositors' Frames, Offices, Schoolrooms, Hospitals, etc., etc.

Advt. of The Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17.

TO OUR READERS.

ELECTRICITY is published every Friday, and is on sale at the principal Railway Station Bookstalls and Newsagents on that day. It has a very large sale throughout the United Kingdom, as well as in the British Colonies and abroad.

New advertisements for the displayed columns and alterations to existing ones must reach the publishing office not later than first post Monday morning, and proof revisions by Wednesday midday at latest, in order to be in time for the issue of the following Friday. This is important. Rates quoted on application. Subscription: 13s. a year, 6s. 6d. half-year, 3s. 3d. a quarter in advance, postage prepaid in the United Kingdom and abroad.

Questions to which an answer is required must be accompanied by a 1½d. stamp for reply. When considered of sufficient interest, the answer will probably appear in the paper. Correspondence is cordially invited, and must always be accompanied by the writer's name and address, although not necessarily for publication.

All remittances payable to the Publishers, S. RENTELL & CO., LTD., 36-39, Maiden Lane, London, W.C. 2. Telephone No. 2460 Gerrard.

Current Topics.

Xmas Greetings.

As this issue, although dated for December 26, will be actually published prior to that date, I wish all readers a happy Christmas and more prosperity in 1925. It looks as if it will be better for the engineering trade generally.

Broadcasting—

Broadcasting still continues to make good progress, and the inception of the new high-power station has enormously increased range of reception for owners of simple crystal sets. Its ultimate venue in the neighbourhood of Northampton, and the proposal to broadcast separate programmes, will doubtless add to the enjoyment of many thousands of listeners, although it will presumably add to the troubles of the Director of Programmes, whose capacity for providing such diverse and, in the main, acceptable fare I greatly admire. Incidentally I am of the opinion that symphony does not at present lend itself to broadcasting. It may be due to the fairly full orchestras, or the fact that certain sounds are distorted in relation to others, but whenever it has been my privilege to listen to a symphony broadcast I have never enjoyed the entertainment as I should have done had I heard it at first hand. According to the dictionary, symphony is defined as "a consonance of harmony of sounds, agreeable to the ear; a musical composition for a full band of instruments." As it has reached me through the medium of broadcast it has been anything but "agreeable to the ear," an opinion which I find shared by a good many other listeners I have consulted.

On the other hand, vocal and instrumental items of the lighter class, with definite themes or airs running through them, come out well on the loud-speaker. All the indications point, therefore, to the fact that there is at present lacking a perfect reproducer for complex musical sounds such as those incidental to what is popularly known as "high-brow" music. I really think that the popular controversy over "high-brow" *versus* "low-brow" broadcast is not so much a question of public taste as the fact that the two classes of entertainment do not reproduce with equivalent effect when broadcast. For this reason I always select a popular programme in preference to a symphony whenever there is a choice. Listening in to a relayed American transmission the other night for the first time since last winter's experiments, I was also impressed with the fact that we are still very much at the mercy of the elements in this matter of long-range transmissions. No doubt the assiduous band of workers at 2LO have spent many weary hours and burnt much midnight oil (or juice) in a praiseworthy effort to solve the problem of Transatlantic broadcasting. No doubt they have also added considerably to the technical knowledge of the problems which beset it. At the same time, it must be confessed that we are not yet in a position to advance much beyond the experimental stage. Nevertheless, the mere accomplishment is a wonderful thing, and a tribute to the pioneer experimenters.

—And Organs.

Incidentally, I heard from Philadelphia what purported to be the "largest organ in the world," and thereby hangs a tale. Until the British Empire Exhibition was in being I had always understood that Sydney, New South Wales, laid claim to possessing the largest organ in the world as part of the equipment of its Town Hall. Then the authorities responsible for the Stadium claimed to beat all records with their mammoth instrument, which was used in connection with the Choir Festivals, Pageant of Empire, etc. Now comes the claim in connection with the Philadelphia organ that it is the biggest yet, and I expect it will take a "Philadelphia lawyer" to settle the matter. In any case, as a matter of general interest, I should be interested to know what organ is really the record breaker, and if any reader has authentic information which will assist in deciding the issue I shall be happy to hear from him.

Why?

I was amazed to note the stipulation attaching to an inquiry in a British trade journal for electrical fittings, and which has been sent on to me by an esteemed correspondent with obvious comments. The inquiry emanates from a Colonial railway company, and is for a fairly large quantity of ceiling roses, cut-outs, lampholders and wall sockets and plugs. The sting comes in the tail: "To be of German manufacture." Now, in the present state of unemployment in this country, what on earth does a buyer hope to gain by specifying and insisting on Continental manufacture for the goods he requires? Competition is keen enough in all conscience to ensure that the price would be right, and, in all probability, if the order were to be placed on a price basis alone, it would go to Germany in the natural course, and may the buyer deserve all he gets. But why specify German goods, and where is the patriotism of the editor who passed the item for publication?

Glasgow Adopts Motor-'Buses.

Among the latest converts to a municipal motor-omnibus service is Glasgow, which thereby modifies its tramway traditions extending over many years. Glasgow Corporation first laid down its tramway system in 1872; then it leased the system to a private omnibus and tramway company, but subsequently reacquired the system. Recently a service of motor-omnibuses has been inaugurated between the east end of the city and Maryhill, via Partick. Blackpool, on the other hand, has decided to promote a Bill to extend its tramways and carry out other works despite the opposition of a councillor, who pointed out the obsolescence of this method of transport. As a glaring example of the inability of a tramway service to cope with the requirements of modern traffic I know of one case in a northern city where certain works turn out upwards of 5,000 employees at meal times and at the end of the working day. To cope with the very fair percentage of this mass of people who would ride if facilities existed, the corporation tramway service is only able to provide two tramcars, the holding capacity of which, allowing for the licensed overcrowding which invariably ensues, is, at the utmost, 160 to 170. Contrast this with the handling of the Wembley omnibus traffic at rush hours.

Atom-Splitting and the Modern Alchemist.

Some new and interesting light on Dr. Wall's experiments, aimed at the disintegration of the atom, was shed by him in the course of a lecture on "Intense Magnetic Fields," before the Mathematical Physical and Chemical Students' Societies at the Imperial College of Science. Dr. Wall described his experiments which, it will be remembered, provided the lay Press with sensational headlines some time ago, and called forth a rebuke from the experimenter. Dr. Wall's method has been to take a magnetic substance and to surround it with a coil of wire, through which he passes an extremely heavy magnetising current of some 40,000 amperes. To obtain this concentrated field the current is stored in a battery of condensers and discharged through the solenoid through the medium of a mechanically driven switch. An essential feature of this method is that the current should be intermittent. The effect of this intense magnetisation was twofold: it tended to force the electrons circulating around the nucleus in the atom either towards or away from the nucleus, and it tended also to reduce the speed at which the electrons were moving around the nucleus. One of the chief difficulties had been to keep the magnetising coil intact. On several occasions this had fractured and the flying fragments had forced their way through the coil and smashed the containing vessel.

In connection with these interesting atomic experiments it is opportune to record that Prof. A. Miethe, of Berlin University, claims to have transmuted mercury into gold. Details of his experiments were as follows. Approximately 3¾ lb. of mercury were used in a mercury arc lamp. The lamp was operated for 197 hours with from 160 to 170 volts and a current density of twelve and a half amperes. At the end of this period gold had been produced to the amount of rather less than three-millionths of an ounce. The reason for attempting the transformation of mercury into gold is far less romantic than that actuating the old alchemists. The question of material gain entered into their calculations. Modern physicists are interested in it in this connection because it is easy to manipulate, and its atom contains in the nucleus one more unit positive charge than does gold. Consequently an atom of mercury should become an atom of gold if a negative unit of electricity neutralised one of the positive units on the nucleus of the atom. Further developments of Dr. Wall's interesting investigations will be awaited with considerable interest.

A Scientific Mr. Squeers.

We have all known, in a more or less vague fashion, that electricity had other uses besides the lighting of lamps and the running of motors. For instance, it has been utilised for its curative properties, and then (to go to the other extreme) in the U.S.A. they use it to despatch you in what is reputed to be an expeditious manner. It is in "God's own country" that we find electricity being turned to a new use. Sure enough, the actual effect produced by the "juice" is familiar enough, but the *application* seems novel. A certain enterprising schoolmaster, wishing to be up to date, decided that knuckle-rapping and other methods in the education curriculum were old fashioned.

Accordingly, he installed a chair such as is used for the electrical treatment of rheumatism, etc. Our modern Mr. Squeers, however, had equipped the chair with a high-voltage induction coil, and he was in the habit of making fractious pupils sit in this chair and then turning on the current. One day he overdid it, and (it is alleged) burnt holes in a boy's leg. I think you will agree that this sort of devilish and calculated brutality deserves a punishment at extra high tension in his own chair. I don't suppose for a moment that this is the kind of sentence he'll get. But there, the law always is a "hass" in whichever part of the globe it's administered!

One Up for France—

I had always thought that in France they were far more progressive in the way of popularising electric lighting than we on this side of the Channel. I remember once strolling into a French fishing village perched on the sea-coast, many miles from any important centre, and certainly far from any industrial district. Happening to visit a small shop, I was astounded to see an Osram lamp hanging there, and then discovered that not only was all that village lighted electrically, but that a number of neighbouring hamlets were all interlinked. This was some years ago. I might say that, although the house and feeder wiring would have made some of our regulation-ridden officials have a doubtle fit on the spot, no trouble seemed to be encountered.

And One Down!

Well, as I said, I had always thought of France giving us a lead, and (as incidents do) the above experience confirmed this in my own mind. But I was staggered recently to read that the National Library in Paris has only just had electric lighting installed. I was not so much staggered at this as at the fact that before the change they *depended upon the sun*! The result was that in winter readers could not continue their studies for more than half a day. Seems queer. In the words of a recent song, "I *am* surprised," or, to quote a learned friend's invariable rejoinder, "*Honi soit qui mal de mer.*"

Humorous Advertising.

I expect my readers have already noticed that our advertising columns have been invaded by the pictorial humour of the St. Helens Cable and Rubber Co., who are so well known as the makers of the C.T.S. wires which they claim can be used for almost any and every purpose under the sun—or moon, for the matter of that. Their artist seems to have a happy knack of designing one comic picture after another and yet always of gaining a good advertisement for one or other of the many advantages of C.T.S. Such publicity must represent a lot of trouble and work in the office, but I am confident that in the long run it is a very paying investment which brings the company many inquiries. In plain language these pictorial stunts attract attention, especially when a new illustration is used each time, and, if the advertisement columns are thereby studied more carefully, the result is an advantage all round. That is the way I have always looked at it, although I may be looked on as the doctor who naturally enough believes in his own medicine. As Mark Twain said: "There is a lot of human nature in a man."

ELEKTRON.

TELEPHONY.*

Being solutions to the questions set in Grade I. examination of Telephony held by the City and Guilds of London Institute on May 1, 1924.

(*Continued from page 701.*)

Q.—What types of battery are used (*a*) with subscribers' telephones, (*b*) in small C.B. *signalling* exchanges, (*c*) in small magneto exchanges, (*d*) in large magneto exchanges, (*e*) in C.B. exchanges? State why the types you name are used.

A.—For subscribers' telephones, which use comparatively little current, the small form of Leclanché cell known as the 2A type is used as a rule. When, however, the local conditions are such that there is a likelihood of wet cells being upset, or where the temperature is such as to cause excessive evaporation of the electrolyte, dry cells may be used. Two cells are required for each subscribers' telephone set. Subscribers' working to C.B. exchanges do not, of course, require batteries. In C.B. signalling exchanges a battery of 24 volts is required for signalling purposes on all lines, and at small exchanges consists of Leclanche cells No. 2A. At larger exchanges, where the output required is greater, Leclanche cells No. 1 or No. 0, which have a greater capacity than the 2A type, are used. It is usual to provide a reserve battery for use in case of the temporary breakdown of the main working battery. In addition to the above batteries, small batteries are required for the operator's speaking set and for the alarm bell circuit, each consisting of two cells Leclanché No. 1.

In magneto exchanges, Leclanché cells are used for the operator's speaking sets. Where lamp signalling is introduced, a 24-volt secondary battery is employed in addition. Secondary batteries are used for the latter purpose to prevent fluctuations in the brilliancy of the lamps when one or more are working simultaneously from the same battery. Owing to the considerable internal resistance of primary cells, if all the lamps were connected to such a battery, their brilliancy would vary accordingly to the number working at any instant.

Owing to the large output of secondary cells, and the advantages accruing from their negligible internal resistance, they are invariably used in C.B. exchanges. The number of cells varies with the system adopted: thus, in the 22-volt repeating coil system, there are 11 cells; in the 24-volt condenser and retard coil system, 12 cells; in the 40-volt condenser and retard coil system, 20 cells. The 22-volt and 24-volt systems require an additional battery of three or four cells for operating the meter circuits. The capacity and size of the batteries depend on the current output required.

(*To be continued.*)

---

* Consult *Questions and Solutions in Telegraphy and Telephony*, Grade I., by Few. Price 5s. 10d. post free from ELECTRICITY Office.

CALENDARS, DIARIES, ETC.

We have to thank Messrs. Siemens for the very convenient and useful pocket diary for 1925, which has just made its regular annual appearance, and has been put into use without delay.——From Crompton and Co., Ltd., the well-known electrical engineers, of Chelmsford, we have received a monthly calendar for the year 1925, each sheet of which contains an attractive illustration of one or more specimens of plant and apparatus manufactured by them for clients in Great Britain and other parts of the world.

From the Hart Accumulator Co., Ltd., we have, as usual, to acknowledge the receipt of the ever-welcome calendar blotting-pad for 1925. It will replace the one which has done yeoman service during 1924.

The **London Electric Wire and Smiths, Ltd.**, of Playhouse Yard, Golden Lane, London, E.C.1, announce that they have obtained the sole selling rights of the well-known insulating specialities manufactured by the Standard Varnish Works. These include Voltalac and Standard air-drying insulating varnish, and arrangements are being made to stock large quantities so that immediate delivery can be made to customers. All the varnishes will be tested before leaving the company's factory at Leyton, and their technical research laboratory is being considerably extended in order to cope with this important work. They therefore invite all readers who are interested in such varnishes to write and ask for a booklet giving a full description of the products which they are now placing on the market.

From the **E.D.A.**, at 15, Savoy Street, London, W.C.2, we have received a catalogue illustrating a large number of the attractive advertisement blocks and stereos which they are prepared to supply at very moderate rates to electrical contractors and retailers, and, indeed, to any and every firm who trade in electrical supplies. These blocks have all been most carefully designed in order to have the greatest possible attraction for the reader, and, therefore, to represent trade pulling power, and we can most strongly recommend all our trade readers to apply to the E.D.A. for a copy of the catalogue. The blocks should be of material assistance in promoting the large increase in trade to which all who are associated with the electrical industry are looking forward with such keen anticipation.

ELECTRICAL ENGINEERING.—FINAL GRADE.*

Solutions to Questions set at the 1924 *Examination of City and Guilds Institute.*

By Edward Hughes, B.Sc., A.M.I.E.E.

(*Continued from page* 689.)

Q. 7.—Describe the action of the motor converter. Evolve an expression for the mechanical and electrical output of the induction machine in terms of the number of poles in the two machines. Give a diagram of connections for starting, and state how voltage regulation is obtained.

A. 7.—A motor converter consists essentially of an induction motor coupled mechanically and electrically to a D.C. generator. Fig. 5 shows diagrammatically the connections of a three-phase machine. Stator winding *S* is wound so as to run directly off the supply voltage. Rotor winding *R* is shown with only three phases, whereas it is generally wound for 12 phases. The principle of action, however, is exactly the same. The corresponding ends of the three phases are brought through slip-rings to a starting resistance *B*, which is sometimes variable, but more often adjusted to a definite value. The other ends of the rotor winding are joined to suitable tappings on armature *A*, which in other respects is exactly similar to a D.C. armature. *F* represents the shunt winding of the second machine, and *D* is the shunt regulating resistance. The two machines are directly coupled to each other. *C C* are switches for short-circuiting the starting resistance *B*.

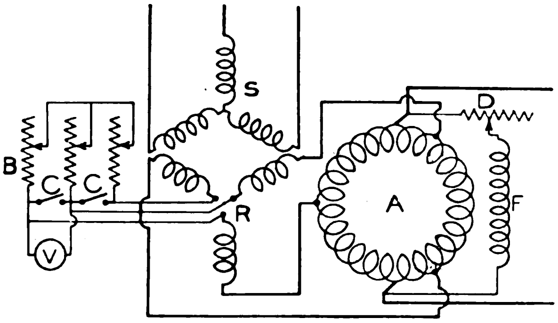


Fig. 5.

Let us, for the moment, assume that the set is running at half the synchronous speed of the first machine, and that each machine is wound for two poles. With a supply frequency of, say, 50, the speed of the rotating field set up in the first machine is 3,000 r.p.m., and consequently the rotor winding is being cut by the rotating field at a speed of 1,500 r.p.m. The 25-cycle e.m.f.s induced in *R* are now applied to the tappings of armature *A* and therefore give rise to a magnetic field rotating at 1,500 r.p.m. relatively to the armature, and stationary relatively to the poles, if the tappings of *A* are in the right sequence. In other words, the second machine—regarded as a rotary converter—is running at synchronism, and a constant voltage is therefore obtainable from its commutator. The first machine is also operating partly as an induction motor driving the second machine as a D.C. generator.

Taking the general case of the first and second machines wound for p_1 and p_2 pairs of poles respectively, we have—

$$\text{Speed of rotating field in first machine} = \frac{60f}{p_1}$$

where f = supply frequency.

If R = synchronous speed of *set* in r.p.m.,

$$\left.\begin{array}{l}\text{frequency of e.m.f. induced}\\ \text{in rotor of first machine}\end{array}\right\} = \left(\frac{60f}{p_1} - R\right)\frac{p_1}{60}$$

$$= f - \frac{Rp_1}{60}$$

Since this frequency is applied to armature of second machine,

$$\left.\begin{array}{l}\text{speed of rotating field of second}\\ \text{machine relatively to its armature}\end{array}\right\} = \left(f - \frac{Rp_1}{60}\right)\frac{60}{p_2}$$

But this field is stationary relatively to the poles,

$$\therefore \left(f - \frac{Rp_1}{60}\right)\frac{60}{p_2} = R$$

$$\therefore R = \frac{60f}{p_1 + p_2}.$$

Let W = total power transmitted from first machine;

W_m = power transmitted mechanically from first machine;

and W_e = power transmitted electrically from first machine.

For a given current in rotor R, and, therefore, for a given torque, the mechanical power transmitted from the first machine to the second is directly proportional to the speed, whilst the electrical power transmitted is proportional to the e.m.f. generated in R and therefore to the slip of R relatively to the rotating magnetic field produced by S.

$$\text{Hence } \frac{W_m}{W} = \frac{\text{speed of rotor}}{\text{speed of rotating field}}$$

$$= \frac{60f}{p_1 + p_2} \times \frac{p_1}{60f} = \frac{p_1}{p_1 + p_2}$$

$$\text{and } \frac{W_e}{W} = \frac{\text{slip of rotor}}{\text{speed of rotating feld}}$$

$$= \left(\frac{60f}{p_1} - R\right)\frac{p_1}{60f} = \frac{p_2}{p_1 + p_2}$$

From the above expressions it follows that the second machine deals as a D.C. generator with $\frac{p_1}{p_1 + p_2}$ of the total power; and as a rotary converter with $\frac{p_2}{p_1 + p_2}$ of the total power.

The voltage regulation is obtained entirely by the excitation of the second machine. This is due partly to the latter acting to some extent as an ordinary D.C. generator, and partly to the reactance of the first machine altering the voltage supplied to the tappings of the D.C. armature just as in the choke-coil regulation of rotaries.

The motor converter is started up like an ordinary slip-ring induction motor, switches *C C* being open and armature A serving as the star-connection of winding R. As the set approaches its normal running speed, the second machine commences to excite and voltmeter V begins to oscillate, the frequency of these oscillations decreasing as the set gets nearer synchronism. A zero reading on V means that the voltages induced in the corresponding phases of R and A are in exact opposition. The oscillations on V are, therefore, made very slow by varying either B or D, and switches C C closed when the pointer on V is at zero, the set being then in synchronism.

---

* Books recommended are *Continuous Current Electrical Engineering* and *Alternating Current Electrical Engineering*, both by Maccall (each 15s. 6d., post free), and *Alternating Current Electrical Engineering*, by Kemp (17s. 6d., post free), from S. Rentell and Co., Ltd., 36, Maiden Lane, London, W.C.2.

Rotor R is usually fitted with a short-circuiting and brush-lifting gear whereby the ends of the other nine phases, which are open during starting, are short-circuited along with the three phases connected to the slip-rings.

(To be continued.)

Our Wireless Corner.

Senatore Marconi's Short Wave Experiments.

The experiments with Senatore Marconi's new system of short wave wireless telegraphy, which he recently described in his inaugural lecture as chairman of the Council of the Royal Society of Arts, have been continued, and during tests on the night of Wednesday, 17th inst., messages were transmitted from the Prince of Wales, the Rt.-Hon. L. S. Amery, M.P., Colonial Secretary, and Viscount Burnham, to the *Cape Argus*, South Africa.

The messages sent were as follows :—

From the Prince of Wales :

" His Royal Highness has heard with great interest of the development of wireless between this country and South Africa."

From the Colonial Secretary :

" I gladly take an opportunity of sending a message to South Africa by means of this new experiment in wireless telegraphy. Cheap, rapid and reliable communication is vital to the needs of the Empire, and I wish to offer my heartiest congratulations to all who worked to bring England and South Africa nearer together."

From Viscount Burnham :

" With my visit to South Africa freshly in mind, I am deeply interested by the successful experiments in short wave wireless transmission between England and South Africa. I feel we are on the threshold of new and closer relations with the Dominions through this channel of communication, and as president of the Empire Press Union, I trust wireless telegraphy, as an alternative to cables, will enable a greater volume of Empire news to circulate."

A Wireless Appreciation.

On Tuesday, December 16, the original male staff of the Mullard Radio Valve Co., Ltd., of Nightingale Lane, Balham, were entertained by the directorate to commemorate the fourth anniversary of their united efforts. After dinner at Pinoli's, the little gathering of fourteen adjourned to the Hippodrome and thoroughly enjoyed the performance of "Leap Year" During a pleasant evening's entertainment, appropriate remarks were made by the managing director, Mr. S. R. Mullard, M.B.E., A.M.I.E.E., and Mr. C. F. Elwell, Fel.I.Rad.E., director, on the wonderful progress made by the company since its inception in 1920, and the former expressed his appreciation of the high sense of duty and personal interest shown by those present, in materially assisting to place the firm in the premier position it holds to-day in the wireless world.

Marconi Valves.

Messrs. Marconi's Wireless Telegraph Co., Ltd., have been kind enough to send us a copy of their pamphlet No. 233, giving details of Marconi valves, made at the Osram Lamp Works. In common with other Marconi pamphlets of the same class, it is an excellent publication. It illustrates the complete range of standard Marconi transmitting, rectifying and receiving valves, and, in addition, technical data, such as filament volts and current, anode volts, impedance, voltage magnification, dissipation, etc., are given. Each valve is dealt with on a separate sheet, and characteristic curves of an average valve of the type and class referred to are published in each case. It should be in possession of every user of Marconi valves, as by a careful study of the information, the best operating conditions may readily be determined. About forty different types of valves are scheduled and suitably indexed.

New Trade Literature.

Three new wireless catalogues have just been issued by the B.T.-H. Co., Ltd., of Mazda House, Upper Thames Street, London, E.C.4. They are R7491B, giving illustrations and details of the latest type of the Paris coil for use with B.T.-H. crystal receivers; R7360, which illustrates and describes the latest type of Radiola portable receivers and accessories; and R7390C, which deals with B.T.-H. loud-speakers and amplifiers. These lists should all appeal directly to every trade dealer in wireless goods, and can be supplied properly overprinted with the retailer's name and address, so that they should represent excellent means for pushing trade. It is to be hoped that our readers will take full advantage of this opportunity.

A new folder illustrating and describing the Wuncell wireless valve as manufactured by Messrs. A. C. Cosser, Ltd., of Aberdeen Lane, London, N.5, is certain to meet with a ready welcome from wireless retailers generally, more particularly as it can be overprinted with name and address if so required. In it are given six excellent reasons for selecting the Wuncell for use in ordinary valve receiving sets, and they will be perused with interest by all users. There is also an article explaining why the Wuncell valve has been designed to operate from an accumulator.

Crystal Palace School of Engineering.—On Wednesday, December 17, Dr. John S. Owens, B.A., A.M.I.C.S., F.R.S.I., F.R.G.S., the well-known fog expert, addressed the students of the Crystal Palace School of Engineering, and distributed the certificates. He remarked upon the contrast between school training with its absence of heavy responsibility and professional practice, where responsibility and financial consideration are prominent. He impressed upon the students that their training was intended to enable them to accept such responsibility faithfully. He also advised students to specialise when possible, saying that the accumulated mass of knowledge was so great that no man could hope to master many subjects. In conclusion, he impressed upon the students the human side of their problems; these always involved relations with other people, and they should be made upon mutual confidence and strictly upright behaviour.

ILLUMINATING ENGINEERING.

At a meeting of the Scientific and Technical Circle of the Institute of Journalists on December 18, Sir Richard A. Gregory presiding, Mr. Leon Gaster traced the development of the illuminating engineering movement during the past twenty years. He recalled that in 1905 he advocated, in the Times Engineering Supplement, a standard specification for electric lamps. Such a specification was now in existence, and both manufacturers and users contributed to the framing of it. Further reminiscences led to an account of his visit in 1907 to the United States, where an illuminating engineering society had just been formed. On his return he started the *Illuminating Engineer*, and in 1909 was instrumental in founding the Illuminating Engineering Society, in London—the first body of the kind to be formed in Europe.

Since that date an interest in all forms of lighting had sprung up in other countries, and illuminating engineering societies had been formed in Austria-Hungary, Germany and Japan. Various aspects of lighting had been dealt with at many international congresses—notably the first international conference on industrial hygiene, and the meeting of the International Illumination Commission (a body with national committees in all the chief countries) this year. Lighting, in short, had become a subject of international interest.

The importance now attached to good industrial lighting, as an essential to health, safety and efficiency, in 1913, led to the formation by the British Home Office of a special departmental committee to study this subject. It was anticipated, in accordance with this committee's reports, that provisions requiring adequate and suitable lighting would be embodied in the Factory Acts in the near future. Details could only be dealt with on the basis of recommendations.

The Illuminating Engineering Society was now embarking on a widespread scheme for promoting public appreciation of the benefits of good lighting.

In conclusion Mr. Gaster pointed out that good lighting was of interest to all sections of the community and that the daily and technical press could render most valuable service in bringing home its importance to the public.

Questions and Answers by Practical Men.

RULES.

QUESTIONS: *We invite our readers to send us questions, preferably on technical problems that have arisen in actual practice. Questions which we consider of sufficient interest to our readers will either be replied to under "Answers to Correspondents" or replies will be invited from our readers. One shilling will be paid for the question which we select for competitive replies in this column.*

ANSWERS: *A fee of 10s. will be paid for the answer which we consider shows the greatest merit, and 5s. for the one we select as second best. In judging the replies, importance will be attached to clearness and conciseness, as well as accuracy. The Editor reserves the right to make no award, or to accept only one reply, if, in his opinion, the answers received do not possess sufficient merit. Competitors desiring the return of their manuscripts, if unaccepted, should enclose stamped addressed envelope.*

Write on one side of the paper only, and if diagrams are sent, draw them on a separate sheet of paper attached to the manuscript. Competitors may adopt a "nom de plume," but, both in the case of questions and answers, the competitor's real name and address must be sent with the manuscript as a guarantee of good faith. No correspondence will be entered into with regard to the successful replies. The Editor's decision is final.

Commencing with question No. 101, a Diploma of Merit will be awarded to the six competitors who win the first or second prize the most times during the next twelve months.

The words "Questions and Answers" or "Q" and "A" should be placed at he top left-hand corner of all letters intended for this column.

QUESTION NO. 193.

I wish to electrify a half-ton hand winch. This is used to lift wood to a height, through a derrick, of 45 ft. I would appreciate full details as to how the electrification can be carried out. The power supply available is 440 volt three wire.—"A. BAKER," Croydon.

QUESTION NO. 194.

Can any reader tell me how I can best make micanite paper for insulating armature coils for 600 volt traction motors?—"E. A. B." Wimbledon.

(Replies to Questions Nos. 193 and 194 must be received not later than December 27, 1924.)

Answers to Questions.

The second prize (5s.). to Question No. 187 has been awarded to "M. M." for the following reply:—

Without examining the motor it is impossible to suggest any simpler method than that proposed; it is, however, sometimes possible to run a motor at double its rated voltage by means of a few alterations. If "H. W. May" can reduce the air gap and also connect a resistance in the shunt circuit the desired end may be attained. In some motors liners can be inserted behind the magnets; to put a resistance in the shunt is a simple proposition.

If it is decided to employ a resistance for the purpose such resistance must take up

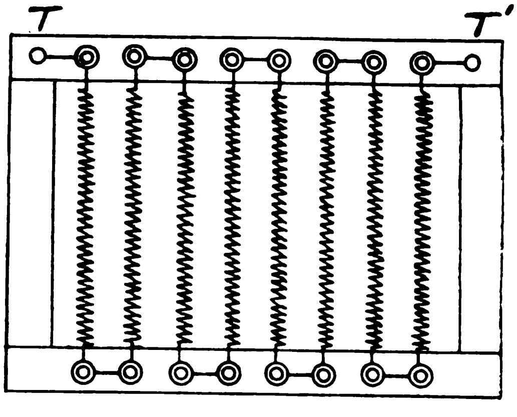
$$(210-100) = 110 \text{ volts}$$

with a current of 3 amperes. Therefore the value in ohms

$$= \frac{110}{3} = 37 \text{ (approx.)}$$

Using No. 18 S.W.G. Eureka resistance wire, this will mean 8 yards. If this is wound in a helix, half an inch in diameter and one-quarter inch pitch, we shall have eight six-inch lengths for the coils.

Four pieces of iron strip $1\frac{1}{4}$ in. by $\frac{3}{16}$ in. (two 10 in. and two $7\frac{1}{2}$ in.) are riveted together to form a frame.



Sixteen porcelain insulators are fastened by screws to the frame and the resistance coils attached to these insulators. TT^1 are insulated terminals. The accompanying sketch will explain construction. Cost of material ten or twelve shillings.—"M. M."

Quotations Wanted.—The State Electricity Supply Works at Montevideo invite tenders for the supply of lubricating oil.——Also for the supply of 104.500 metres of rubber insulated cords of various sizes and colours.——Also for tenders for the supply of 745,000 metres of special cables for outside use under inclement conditions (Hackethal type).——Also for the supply of copper wire and cable. Further particulars from the D.O.T., 35, Old Queen Street, London, S.W.1.

Reviews of Books, &c.

[Books noticed in this column will be sent from **ELECTRICITY** *Office to any part of the world, for the published price, plus five per cent. for postage (minimum 2d.), and orders will be appreciated.]*

THE ENGINEERING ACTIVITIES OF THE WESTINGHOUSE ELECTRIC AND MANUFACTURING CO. FOR 1924.—This pamphlet is a comprehensive review of the work of the American Westinghouse Co. for the past year. An account is given of the progress in the design and construction of turbines, turbo-alternators, synchronous converters, rotary converters and transformers. Considerable increase in the use of automatic control is recorded. In the field of transportation the Diesel-electric has been successfully applied to all classes of ships, whilst a large number of electric locomotives has been placed in service, for voltages including 600 and 3,000 D.C., as well as motor generator types operating under 11,000 volts single-phase trolley.

A number of items deserve special mention. We notice a 35,000 k.v.a. frequency changer, with special sprung supports for damping out the vibrations due to the pulsating torque caused by the 25-cycle single-phase load. Three 30,000 k.v.a. synchronous condensers have been put in service, the losses of these machines being less than 2 per cent. of their k.v.a. rating. The intervalve transformer, designed to eliminate sludging troubles and risk of explosion, uses nitrogen above the oil surface, the nitrogen being derived from the atmosphere by passing the air breathed by the transformer through dehydrating chemicals.

The pamphlet is profusely illustrated, and forms an interesting and instructive account of up-to-date American practice.

PITMAN'S RADIO YEAR BOOK, 1925. (Pitman, 1s. 6d. net.)—This is the third year in which this valuable Year Book has been issued. The 1925 edition has been broadened to keep pace with the rapid progress which has been made in broadcasting during the recent twelve months, the outstanding features of which are described and very amply illustrated. The many photos of the various Uncles and artistes of note should prove of very great interest to all listeners-in, as they convey some idea of the personality behind the voice.

The technical and commercial sections are excellent, and contain valuable articles and notes on many important wireless matters. The book has been modified, evidently with a view to making a special appeal to the average listener-in, rather than to the wireless amateur, and it is regretted that the amateur station list has been omitted. It is questionable as to whether the Trade Directory and particulars of the various manufacturers' associations, make any appeal to the average purchaser of the book, but nevertheless it is very good value for money, and will without doubt be welcomed by the purchasers of the two previous editions. One other thing we are sorry to see has been omitted, and that is the two distinct colours on the back edge of the book. This was a speciality of the last edition, and made its discovery in the bookcase or book pile a matter of ease.

KELVIN CENTENARY ORATION AND ADDRESSES COMMEMORATIVE. Demy 8vo. Cloth, 100 pp. (Lund, Humphries, 6s. net.)—Readers of ELECTRICITY are, of course, familiar with the main celebrations during the summer of the centenary of the birth of Lord Kelvin on June 26, 1824, and this volume is in effect a reprint *in extenso* of the speeches and addresses delivered at those celebrations in London on July 10 and 11. We were only able to refer to them briefly in our columns, and to have them thus collected and bound is a decided advantage, as it enables one to gain a far better idea of the honour and esteem in which our great British scientist was held in every part of the globe. As a frontispiece, the book contains a beautiful reproduction in colour from the painting in the Council Room of the Institution of Electrical Engineers, and we fully expect the publishers will find a ready demand for a book which appeals to such a wide circle of scientific readers. The oration, speeches and addresses breathe a spirit of praise and optimism which make one proud of one's race.

FACTORY LAY-OUT, PLANNING AND PROGRESS. By W. J. Hiscox. (Pitman, 7s. 6d. net.)—The title explains this work better than a reviewer could, and the title was well chosen.

Present-day factory expenses are high, and it becomes very necessary in every manufacturing plant, whether it be large or small, to organise the system in an efficient manner so that leakages may be prevented, waste stopped, red tape avoided, and general output boosted to a maximum. To endeavour to obtain this ideal condition should be the object and the interest of every member of the staff from the works manager downwards, and Mr. Hiscox's book very ably sets forth very practical ideas on the subject, and shows how the necessary registers and records may be provided and organised.

The progressing of supplies and progress routine for specific circumstances are specially referred to; in fact, progress work constitutes a considerable portion of the book. On this point the writer is specially to be complimented, because however well the works may be run, the proper progressing of material and parts is one of the chief factors in a successful issue.

Unlike some works on factory organisation, Mr. Hiscox's book may be studied with advantage by persons interested in factories of medium size, but the book is more especially valuable to those connected with large manufacturing organisations, as it is in these particularly that systems must be adopted that will in effect reduce establishment charges to the lowest possible limit.

The book is especially recommended to the younger members of the staffs of manufacturing concerns, particularly those who hope one day to become managers or heads of departments, as without more than a superficial knowledge of the matters covered by the book under review they cannot hope for any measure of success.

The book is strongly recommended, and although the diagrams are not numerous, they are clear and amply illustrate the text.

A catalogue of electric furnaces for laboratories has just been issued by **Messrs. Townson and Mercer, Ltd.**, of 34, Camomile Street, London, E.C.3. It should prove of direct interest to all who are in any way associated with experimental and research work, and will therefore appeal to all of the leading firms as well as to the numerous University laboratories, etc., throughout the country.

FOIBLES AND FALLACIES OF SCIENCE. By D. W. Hering. Large Post 8vo, 294 pp., illustrated. (New York, Van Nostrand, $2.50; London, Rentell, 12s. 6d. net.)—This is a decidedly entertaining book which has relieved the tedium of office routine work for quite a number of hours, and it was with regret that the writer turned the last page and arrived at the index. It covers a very broad field and describes lucidly many of the celebrated vagaries of science, as well as giving interesting stories of queer theories, such as the Symmes' theory of earth formation and famous hoaxes like the Keely motor of thirty years ago. Yet some of the imaginative ideas of the centuries which have passed were curious forecasts of the future. For instance, the picture of the air combat between English and German aviators in 1751, became an actuality nearly a hundred and seventy years later, and the theory of the transmutation of metals, so keenly followed by the alchemists of the Middle Ages, is being very seriously considered by many of the leading scientists of the present day. Of course, perpetual motion has its chapter, and there is a well-written section dealing with dowsing, otherwise the art of finding underground water with the aid of the divining rod. Palmistry, phrenology, prophecies and geographical discovery are other subjects on which Dr. Hering writes in a most entertaining manner, while the chapter on hoaxes is also very amusing. The book is one which can be recommended to technical and non-technical readers, and is certain to be appreciated by both.

Various Items.

Tenders Accepted.—The Admiralty have accepted the tender of the Edison Swan Electric Co., Ltd., for a supply of metal filament, traction type and gasfilled lamps, and the G.P.O. have accepted their tender for protectors.

"**M.E.M.**" **Christmas Festival.**—Over 200 members of the M.E.M. Social and Athletic Club attended the annual dinner and concert on Friday, December 19. Everything went very happily indeed, and the whole of the excellent programme was provided by members of the works and office staff of the firm.

Newry.—The Urban Council last week considered applications from electrical engineers to carry out their electric lighting scheme at a cost of £17,500, and Mr. P. A. Spalding, electrical engineer to Dundalk U.D.C., was elected.

Londonderry.—The Corporation have agreed to reduce the electricity meter rents from 3s. to 2s. per quarter, involving a reduction in the revenue of £500 per annum.

Leipzig Spring Fair.—Evidently the forthcoming Spring Fair at Leipzig is going to be a far larger exhibition than hitherto. The technical section has been extended from 80,000 sq. m. to 130,000 sq. m., and almost the whole of the available space has already been taken up. Considerable extension has been made to the electrical engineering section, and we expect this will prove of direct interest to engineers in this country who may visit Leipzig with a view to learning about the latest developments on the Continent.

Meetings.—The Western Centre of the I.E.E. will meet at the Grand Hotel, Broad Street, Bristol, on Monday, Jan. 12, 1925, at 4.30 p.m., when the president of the Institution (W. B. Woodhouse, Esq.) has kindly consented to give an address. This will be followed by the annual dinner at 6.15 p.m.——A Wireless Section meeting of the I.E.E. will be held on Wednesday, January 7, at 6 p.m. Paper: "A New Method of High-Frequency Resistance Measurement," by Prof. E. Mallett, M.Sc., member, and A. D. Blumlein, student

Argentine.—The current issue of the B.O.T. Journal contains an interesting article on the present position of British trade in the Argentine Republic, about which the commercial secretary in Buenos Aires writes most hopefully. He admits that the absence of modern wiring regulations in the Argentine permits the use of cheap and low standards of materials, and this is much to the advantage of German goods, but British manufacturers are better placed for securing orders from British enterprises operating in the Republic, and should do everything possible to cultivate this trade.

Removal.—The Foreign Samples and Foreign Catalogues Section of the Department of Overseas Trade will be removed from its present premises at 7, Old Bailey, E.C., to the headquarters of the Department at 35, Old Queen St., Westminster, S.W.1, during Christmas week. The exhibition of foreign samples will therefore be closed as from Monday, December 22, and will be reopened at the new address on January 1, 1925. All correspondence intended for the Foreign Samples and Foreign Catalogues Section should, after the 24th inst., be addressed to the headquarters of the D.O.T., 35, Old Queen Street, S.W.1.

Trade Notes.

Leaflet 84B, which has just recently been issued by **Gent and Co., Ltd.**, of Faraday Works, Leicester, gives details, illustrations and prices of their patent "Tangent" terminals, to which editorial reference has already been made in the columns of this paper. The full details given in the list are certain to prove of value to installation engineers, as well as to manufacturers of electrical apparatus.

A leaflet which has just been issued by the **Foster Engineering Co., Ltd.**, of Morden Works, Wimbledon, announces a reduction in the prices of certain tyves of their well-known Apex Ironclad switchgear, and should therefore appeal to installation contractors generally.

Engineering Supplies, Ltd., have moved to more conveniently planned premises, situated at 235A, Blackfriars Road, London, S.E.1, and the whole of their correspondence, together with sales, will be effected from this address. Their new telephone numbers will be Hop 6933 (three lines).

A pamphlet dealing with P.84 Silicate of Soda as manufactured for mixing with concrete has just been issued by **Messrs. Brunner, Mond and Co.**, of Northwich, Cheshire, and will be of direct interest to all engineering readers who have anything whatever to do with the foundations and fixing of heavy machinery.

Folder L329, which has just been issued by the **British Thomson-Houston Co., Ltd.**, of Mazda House, 77, Upper Thames Street, London, E.C.4, gives a series of beautiful illustrations of the latest types of B.T.-H. glassware for decorative electric lighting as well as full particulars and prices. The folder can, if needed, be duly overprinted with the name and address of any local electrical contractor or factor, and it should, therefore, prove a most useful trade circular for all readers who are engaged as such.

GRINDERS
DRILLS
"DEPENDABLE"
& POLISHING LATHES
MARRYAT & PLACE, ENGINEERS.
20 HATTON GARDEN, E.C.1.

Sample Pair Sent on Approval for 8/6
Made of Pure Para Rubber, soft and durable and unaffected by climatic conditions
DAVID MOSELEY & SONS, Limited
ARDWICK MANCHESTER.
MOSELEY
RUBBER GLOVES

ELE

ELECTRICITY

A PRACTICAL TRADE JOURNAL

No. 1781.—Vol. XXXVIII. FRIDAY, DECEMBER 26, 1924. [Registered as a Newspaper.] Twopence.

You must have reliable Cables
—that's why you should use
UNION *Rubber Insulated* **CABLES**

Grenly's

Advt. of
Union Cable Co. Ltd., Dagenham Dock, Essex.

"ANTI-SULPHURIC" ENAMEL For Protection from Acid Fumes **"INSULDERM"** Heat Radiating High Insulating Enamel for High Temperature Coils, Prevents Sparking at Commutator Ends.

Sole Makers: GRIFFITHS BROS. & CO., LONDON, LTD., BERMONDSEY, S.E.16.

REGD
LEKTRIK
TRADE MARK

LUNDBERGS'
Electrical
Accessories
ARE STILL THE BEST.
477 to 489, Liverpool Road, London, N.

MICA
AND ALL
ELECTRICAL INSULATING MATERIALS.

ATTWATER & SONS,
Contractors to Admiralty & War Office,
PRESTON, ENGLAND.

Phone Avenue 9362.

THE ACID THAT ADDS LONG LIFE TO EFFICIENCY

Wires Berk London

B.A.A.
REGD

Our trade-mark, BAA, on every carboy is your guarantee that you are getting the purest and best accumulator acid. BAA is made from natural Brimstone and distilled water only, and specially tested. Buy only BAA.

MEDAL AWARDED ST. LOUIS, 1904.

F. W. BERK & CO. LTD
Acid & Chemical Manufacturers since 1870
1 FENCHURCH AVENUE, LONDON, E.C. 3.
WORKS AT STRATFORD, E. & MORRISTON, GLAM.

TAS. 2010.

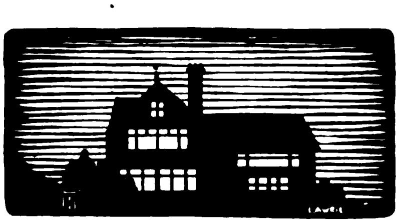
LEW

THE LONDON ELECTRIC WIRE COMPANY & SMITHS, LTD.,
Playhouse Yard, Golden Lane, London, E.C.1.

Rubber Insulated Cables, Telephone Wires, Flexibles, Bell Wires, Instrument and Armature Wires, Fuse & Resistance Wires.

LARGE STOCKS — PROMPT DELIVERIES

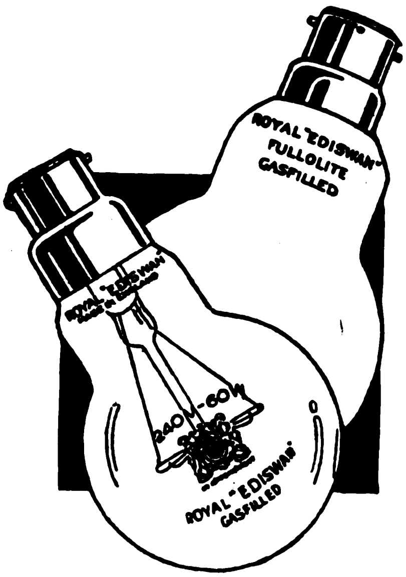
THE LIBRARY OF THE
JAN 9 1925
UNIVERSITY OF ILLINOIS



The **HENLEY** Wiring System

provides the neatest and highest quality installation. It is the ideal method for all buildings in which unobtrusive wiring is desired. Ask for Art Brochure No. D. 257, "Modern Electric Wiring."

W. T. Henley's Telegraph Works Co., Ltd., Blomfield Street, London Wall, London, E.C.2.


ROYAL "EDISWAN" FULLOLITE GASFILLED
ROYAL "EDISWAN"
240V-60W
ROYAL "EDISWAN" GASFILLED

40 years have taught us—

that we cannot take *too* much care in the manufacture of

ROYAL
"EDISWAN"
ELECTRIC LAMPS

Each lamp that leaves our factory is impregnated with this spirit—the spirit of service.

As your customers purchase more Royal "Ediswan" products, so will they appreciate the value of "Ediswan quality.

And so, just as surely, will they appreciate and show it in tangible form, the value of the shop at which they can purchase dependable and economical electric fitments.

Get your supplies *Now!*

WRITE FOR Supplies of our new over-printed literature & attractive showcards.

Send now to

THE EDISON SWAN ELECTRIC CO., LTD.
123-125, Queen Victoria Street, London, E.C.2.
Works, Ponders End, Middlesex.

Fully licensed under Patent Nos. 23499/09, 10918/13 and others.

C.F.H.

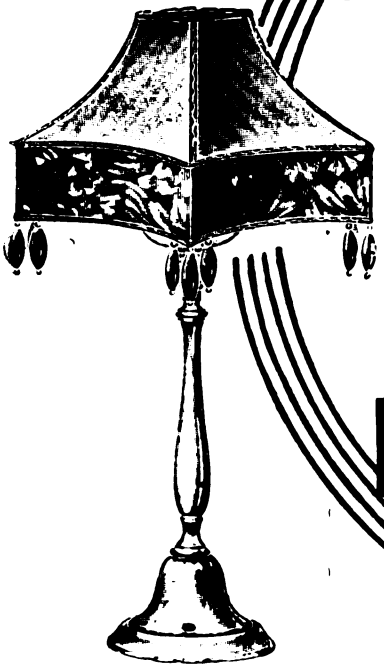


Table Standards

THE two beautiful patterns here depicted are taken from a page of eight elegant Table Standards now included in the Electrical Section of the Welsbach Catalogue. They are supplied in three distinctive finishes :

Polished Brass
Oxidised Copper
Oxidised Silver

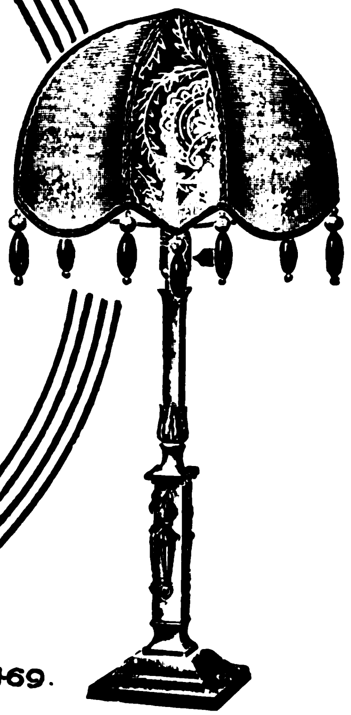
and are of solid, good-for-a-lifetime British manufacture.

Have you got that catalogue ?

WELSBACH

Advt. of the Welsbach Light Co.,Ltd,
Welsbach House, King's Cross,
London, W.C.1.

P.P.S. 469.



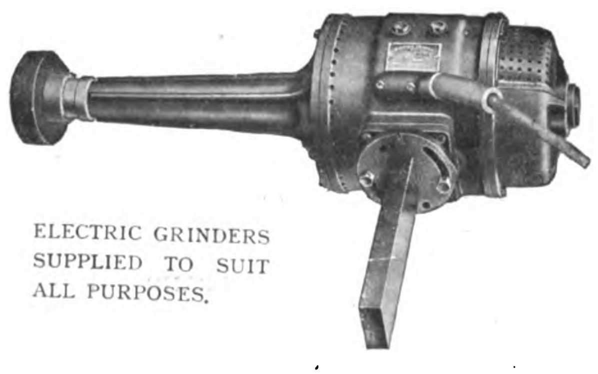
LITTLE GIANT.
PNEUMATIC AND ELECTRIC DRILLS.

CONSOLIDATED CP PNEUMATIC

Have you a copy of our latest Electric Tool Catalogue ?

PORTABLE LITTLE GIANT DRILLS AND GRINDERS SHOULDER HEAVY LOADS WITHOUT UNDUE TEMPERATURE RISE.

THEY ARE EFFICIENT AND SAFE. ECONOMICAL IN MAINTENANCE AND OPERATING COSTS. USED BY THE THOUSANDS.



ELECTRIC GRINDERS SUPPLIED TO SUIT ALL PURPOSES.

Tel. Address :
Caulking, Piccy, London.

Works :
Fraserburgh, Scotland.

Telep. No. :
Gerrard 9215 (4 lines).

Branches
all over the World.

TOOL POST GRINDER FOR MOTOR CAR AND MOTOR CYCLE ENGINE CYLINDERS, WITH AN OVERHANG OF 12 In.

THE CONSOLIDATED PNEUMATIC TOOL CO., LTD.

Head Office: EGYPTIAN HOUSE, 170, PICCADILLY, LONDON, W.1.

Our Fiftieth Christmas

Do we measure time by festivals or balance sheets?

This month we shall have seen fifty Christmases, and as we write, at any rate, we remember them better than the most glowing financial record.

They have been festivals indeed, and looking down the years we realise, that apart from our personal efforts in the cause of Electrical development, we could never have travelled so far along the highroad to success had we not made friends in making customers.

It is therefore in the spirit of friendship, not of commerce, that we tender to them once again our heartiest greetings for the Festival that is old but ever new — greetings that no elaborate phraseology can express so eloquently as do the old, old words —

"A Merry Christmas & a Prosperous New Year"

JOHNSON & PHILLIPS LTD. · ELECTRICAL ENGINEERS · CHARLTON · LONDON. S.E...

Vulmos (REGD) GENUINE VULCANIZED FIBRE

MOSSES & MITCHELL, LTD. 122 & 124 GOLDEN LANE LONDON. E.C.

THE CAMBRIAN ELECTRICAL SCHOOL,

CEMETERY ROAD, PORTH, GLAM.

Principal: WILLIAM THOMAS, M.I.M.E., A. of M.E.E.
Deputy Principal: Dd. I. THOMAS, M.Inst.E., F.R.S.A.

Tutors: Staff of Highly Qualified Instructors in all subjects.

A SCHOOL OF UNEQUALLED REPUTATION. No Branches. No Agents. Influential Employers give preference to Students coached at this Correspondence School.

DO YOU WANT TO SUCCEED?

An efficient Passport to the Best Positions is the Possession of the Electrical Engineering Diploma issued by this School (The C.E.S.) to all diligent Students.

Well-paid and Good Positions await every Successful Student. Commence Now and ensure your Success in Life. Take LESSONS BY POST in Electrical Engineering, Mechanics and Mathematics.

TO ENSURE YOUR SUCCESS AT
ELECTRICAL EXAMS.
STUDY IN PRIVATE AT HOME WITH THE VERY BEST TUTOR

INSTRUCTION UNTIL SUCCESSFUL

Select the Tutor that has an unbroken Record of Successes

At the A. of M.E.E. Exams.
119 *Students passed as* Qualified Electrical Engineers.

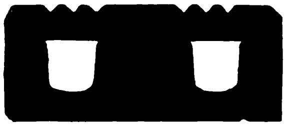
At City and Guilds Electrical Engineering Exams. from 1916 to 1922:–

1,448 students have been successful at the above exams. Such is the record of this well-known school.

To be successful at your next examination, state your requirements, and write to-day for information, free syllabus, and free handbook of exam. questions.

The Secretary (Dept. D), The Cambrian Electrical School, Cemetery Road, PORTH, RHONDDA, GLAM.

CASING AND CAPPING.



BLOCKS, CLEATS,
BOARDS FOR SWITCHES
in stock and made to any design.
ACCUMULATOR CASES
and BATTERY BOXES
Made to Order.

J. F. & G. HARRIS, Ltd.,

Timber Merchants and Moulding Manufacturers.
SAWING, PLANING, MOULDING & GENERAL WOODWORKING MILLS
58g, WILSON ST., FINSBURY, LONDON, E.C.
Telephone No: 1168 London Wall   Please write for Illustrated Price List.

NOTICE THE REAMER ON JAWS

Patent applied for and design registered.

Back view of our World-known and famous "HEART BRAND" Cutting or Bell Pliers in all sizes, 4 in. to 7 in. rising by ½ in., and 8 in., 9 in. and 10 in. sizes.

C. 200R.
6 in. size only, something new in Pliers, that is a reamer for removing burrs inside of conduit tubing without the use of extra tools

WYNN. TIMMINS, & CO., LTD.

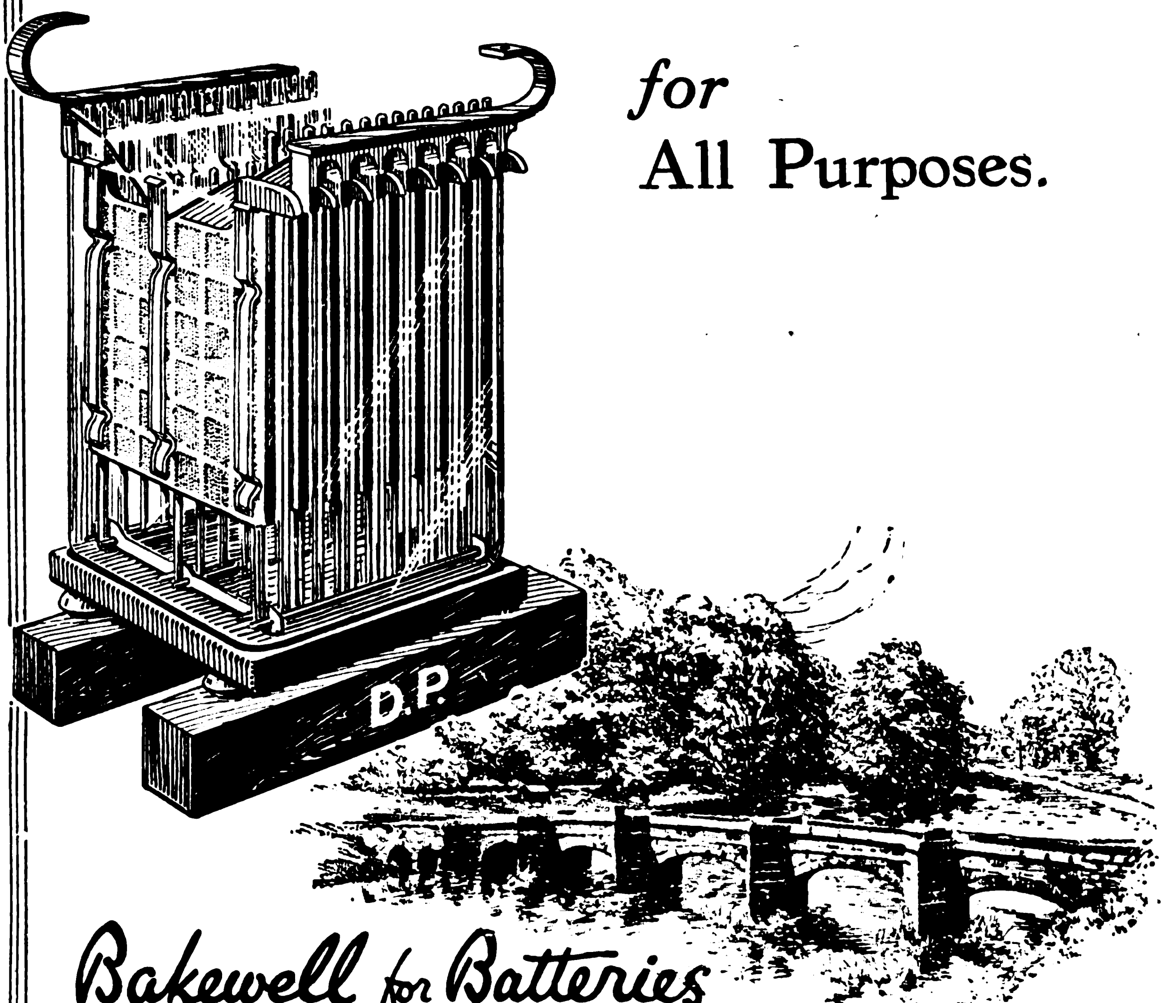
CENTURY WORKS, COMMERCIAL STREET, BIRMINGHAM.

BOOKS

Write to
S. RENTELL & Co., Ltd.
And ask for Catalogue No. 10.

D.P.
STORAGE BATTERIES

for
All Purposes.



Holme Bridge, Bakewell.

Bakewell for Batteries

The
D.P. BATTERY Co. Ltd.
BAKEWELL, DERBYSHIRE.

London Office - - 11, Victoria Street, Westminster, S.W.1.
'Grams { "Battery, Bakewell." "Accumulose, Sowest, London."
'Phones { Bakewell 2. Victoria 1591.

N.C.S. INDUSTRIAL PORTABLE INSTRUMENT.

THIS is yet another of our series of Portable Instruments (which includes a complete range of instruments) and is of the same standard of quality and reliability.

This series of instruments has been specially designed to meet all the requirements of the electrical profession and all instruments are thoroughly tested before leaving our factory.

May we send you full particulars of our series of Portable Instruments?

NALDER BROS. & THOMPSON, Ltd.,
97a, DALSTON LANE, LONDON, E.8.

Telegrams: Occlude, Kinland, London.
Telephone: Clissold 2365 (3 lines).

V.I.R. Cables from Stock

We are now in a position to make prompt delivery of "Callender" Rubber Insulated Wires of practically every type.

"Callender" V.I.R. Cables are built up from the finest materials procurable, by skilled workmen under expert supervision, afterwards thoroughly tested in up-to-date laboratories before being dispatched to the customer.

Specify "Callender" and ensure Reliability.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
Hamilton House, Victoria Embankment.
LONDON E.C.4
Telephone, 8903 Central Telegrams "Callender" Ldn.

DISCOVERY

A Monthly Popular Journal of Knowledge.

Edited by
HUGH B. C. POLLARD.

Scientific Adviser:
A. S. RUSSELL, D.Sc.

Trustees: Sir J. J. Thomson, O.M., F.R.S.; Sir F. G. Kenyon, K.C.B., F.B.A.; Prof. A. C. Seward, Sc.D., F.R.S.; Prof. R. S. Conway, Litt.D., F.B.A.

Few thinking people can have failed to notice a remarkable advance during the last few years in our knowledge about ourselves, individually, socially, and racially, and about the world and universe in which we live.

In the realms of science discoveries are being made that must very shortly affect, or have already affected, the daily life of each one of us. In the older branches of knowledge a flood of new light is being shed on the early experience of mankind. What we have hitherto looked on as the "ancient" civilisation of the Greeks and Romans is now appearing as the last fruit of many thousand years of development, whose records are only now coming to light in Crete and Egypt.

It is the object of DISCOVERY to provide its readers with a journal which will keep them in touch with these many new developments in the arts and sciences.

CONTENTS FOR DECEMBER.

English Paintings in the Middle Ages. By Sir F. G Kenyon, K.C.B., F.B.A.

With the British Association in West Canada. By O.J.R. Howarth (Secy.).

The Sumerians and India. By C. J. Gadd.

The Vitamin Experiments on Chickens. By J. Riley, B.Sc.

The Deciphering of Scorched Documents. By C. A. Mitchell, M.A., F.I.C.

The Imperial Institute and School Museums.

Permanent Photographic Records. By Fred. T. Usher.

Bird Watching in Autumn and Winter. By M.G.S. Best. F.Z.S., M.B.O.U.

The Electric Wind-Jammer. By Frank C. Bowen.

The Chemistry of the Christmas Pudding. By Helen Masters.

Asteroid Hunting.

MONTHLY
1/-
NET.

Annual Subscription 12s. 6d. post free.

BENN BROTHERS LTD., 8, Bouverie Street, E.C.4.

LIST OF BOOKS
Published by
THE ELECTRICAL REVIEW

THE ELECTRIC TRAMCAR HANDBOOK. For Motormen, Inspectors, and Depot Workers. By W. A. AGNEW. Eighth edition. **3/6**, post free **3/8.**

THE PRACTICE OF ELECTRICAL WIRING. By DONALD SMEATON MUNRO, M.I.E.E., M.Assoc. Mining E.E. Written by an Expert, this well-known Handbook, which has just been revised, is of the greatest possible value to Contractors, Engineers, Architects, Wiremen, and all connected with Electrical Wiring. Latest enlarged edition. 267 pp. 100 illustrations. **5/-** net, post free **5/5.**

A PRACTICAL TREATISE ON THREE-PHASE INDUCTION MOTORS. By LEONARD ERNEST WOOD. Associate Member of the Institution of Electrical Engineers, London; late Electrical Engineer of Montreal Cottons, Ltd., Canada; Director of Airdale Manufacturing Co., Ltd., Bradford. Cloth 4½ by 7½, 130 pp., 72 illustrations. **6/6** net, post free **6/9.**

"The primary object of this book is to provide a 'practical aid' to those who have under their care the running, maintenance and repair of three-phase induction motors, and have not either the training or experience necessary to deal with the many practical problems that arise from time to time."

THE "ELECTRICAL REVIEW" LIST OF ELECTRICITY UNDERTAKINGS OF THE UNITED KINGDOM, BRITISH DOMINIONS & FOREIGN COUNTRIES. Giving: Supply Authority; Chief Engineer; Nature and Pressure of Supply and Plant Capacity. **2/-**, post free **2/2.**

THE ELECTRICITY (SUPPLY) ACT, 1919. With Notes by W. S. KENNEDY, LL.B., of the Inner Temple, Barrister-at-Law, Author of "General Conditions in Engineering Contracts." 96 pp. Paper covers, **3/6**, post free **3/8.**

TELEGRAPH SWITCHING SYSTEMS. By T. F. PURVES, Engineer-in-Chief's Department, G.P.O. Contents: Section 1—Early Switching Systems. Section 2—Belgian System of Intercommunication Switching. Section 3—Post Office "Concentrator" System. Sections 4 and 5—London Intercommunication Switching System; Mechanical and Electrical Details. Cloth, **3/-** net, post free **3/5.**

THE COAL CONSUMPTION OF POWER PLANTS AND BONUSES FOR COAL SAVING. By R. H. PARSONS, M.Can. Soc. C.E., Assoc.M.Inst.C.E. 24 pp. Paper covers, **1s.**, post free **1/2.**

HANDBOOK IN CABLE-BREAK LOCALISATION. Graphic Methods. The Calculator Board in Practice. By EDWARD RAYMOND-BARKER, M.I.E.E. Demy 8vo. 66 pp., 38 illustrations. Paper covers, **1/6**, post free **1/8.** Cloth covers, **2/6**, post free **2/8.**

CABLE-FAULT LOCALISATION GRAPHS IN PRACTICE. By EDWARD RAYMOND-BARKER, M.I.E.E., Demy 8vo, 68 pp. 24 illustrations. Paper covers, **1/6**, post free **1/8.** Cloth covers, **2/6**, post free **2/8.**

LOCALISING HIGH-RESISTANCE BREAKS IN CABLES. By J. RYMER-JONES. Demy 4to. Paper covers. **1/-**, post free **1/2.**

SOME PRACTICAL NOTES ON THE COMMERCIAL DEVELOPMENT OF ELECTRICITY SUPPLY UNDERTAKINGS. By R. BORLASE MATTHEWS, Wh.Ex., A.M.I.C.E. Reprinted from the "Electrical Review." Demy 8vo, 48 pp. Paper covers, **1/-**, post free **1/2.**

CONTENTS.—Introductory; Organisation; the System; Canvassing; Aids to Canvassing; Power Canvassing; Advertising; the Showroom; Exhibitions; "Direct-by-Mail" Advertising; Dealing with Enquiries; Canvassers; the Central Station Magazine; Special Propositions; Information File; Electric Signs; Shop Window Lighting; Competition; Mechanical Aids to New Business Getting; Cost of Operating a New Business Department; Gist of the Main Scheme of Operation.

The ELECTRICAL REVIEW, Ltd.,
4, LUDGATE HILL, LONDON. E.C. 4.

THE C. & G. EXAMINERS RECOMMEND

THE FOLLOWING "WORKS OF REFERENCE" FOR THE SESSION 1924-5:—

TELEGRAPHY AND TELEPHONY—

	s.	d.
Elementary Lessons in Electricity and Magnetism. By Thompson...	5	6
Magnetism and Electricity for Students. By Hadley	7	0
Magnetism and Electricity for Beginners. By Hadley	3	6
Practical Alternating Currents. By Smith	10	0
Propagatn. of Elec. Currents in Teleph. and Teleg. Conds. By Fleming	21	0
Telegraphy. By Herbert	18	0
Telegraphy. By Preece	12	6
Construction of Underground Telegraph and Telephone Lines, G.P.O. Parts I. and II. ... ... each	2	6
Handbook of Electrical Testing. By Kempe...	25	0
Elem. Principles of Wireless Telegy. By Bangay. Parts I. & II. each	4	0
Elem. Manual of Radio-Telegy. and Radio-Teleph. By Fleming ...	10	6
Practical Telephone Handbook. By Poole	15	0
Instruction in Army Telegraphy & Telephony. Vol. I. Instruments	1	0
" " " " " " Vol. II. Lines ...	1	0
Construction of Aerial Lines, G.P.O.	1	6
" " Underground Lines G.P.O.	1	6
Autom. Teleph. Systems. By Aitken. Vol. I. 25s., Vol. II. 35s., Vol. III.	55	0
Principles of Automatic Telephony. By Atkins	3	6
Automatic Telephony. By Smith and Campbell	25	0
The Telephone and Telephone Exchanges. By Kingsbury... ...	15	0
Strowger Automatic Telephone Exchange. By Mordin	21	0
Telephonic Transmission. By Hill	21	0

ELECTRICAL INSTALLATION WORK—

	s.	d.
Practical Electrician's Pocket Book. By Crewe	3	0
Principles and Practice of Electric Wiring. By Bursill	5	0
Practical Electric Wiring. By Metcalfe	7	0
Dynamo and Motor Attendants. By Broadbent. (Post 4d.) ...	4	6
Electric Circuit Theory and Calculations. By Maycock " " ...	10	6
Electric Light Fitting. By Batstone...	6	0
Electric Wiring. By Clinton	3	6
Electric Bells, Alarms and Signalling Systems. By White	3	6
Wiring Rules of Inst.E.E....	1	0
I.E.E. Regulations for Electrical Equipment of Ships...	3	6
Home Office Regulations (928)	1	0
Telephone Erection and Maintenance. By White	3	6
Continuous Current Motors and Control Apparatus. By Maycock...	7	6
Magneto and Electric Ignition. By Hibbert...	3	6
Alternating Current Work. By Maycock	10	6
Motor and Dynamo Control. By Ibbetson	21	0
Theory and Practice of Electric Wiring. By Ibbetson	7	6

ELECTRICAL ENGINEERING—

1.—*Elementary.*

	s.	d.
Elementary Lessons in Electricity and Magnetism. By Thompson...	5	6
Magnetism and Electricity. By Brooks and Poyser	12	6
" " for Students. By Hadley	7	0

2.—*General.*

	s.	d.
Practical Electricity. By Ayrton and Mather	15	0
Technical Electricity. By Davidge and Hutchinson	12	6
Theory and Calculation of Electric Currents. By La Cour & Bragstad	18	0
Elements of Electro-technics. By Young	7	6
Whittaker's Electrical Pocket Book. By Neale	10	6
Electrical Engineering. By Thomalen...	28	0
Principles of Electrical Engineering. By Kapp. 2 vols. ... each	18	0
Electrical Engineering Practice. By Meares and Neale ... Vol. I.	25	0

3.—*Continuous Currents.*

	s.	d.
Continuous Current Engineering. By Hay	9	6
Direct Current Electrical Engineering. By Barr	15	0
Continuous Current Electrical Engineering. By MacCall	15	0

4.—*Alternating Currents.*

	s.	d.
Alternating Currents. By Hay	8	6
Foundations of Alternate Current Theory. By Drysdale... ...	10	6
Primer on Alternating Currents. By Rhodes	3	6
Elements of Alternating Currents. By Franklin & Williamson		
Principles of Alternating Current Machinery. By Lawrence ...	25	0
Alternating Current Electrical Engineering. By Kemp	17	0
Alternating Current Phenomena. By Steinmetz	25	0
Theory and Calculation of Transient Electric Phenomena. By Steinmetz	30	0
Treatise on the Theory of Alternating Currents. By Russell. (2 vols.) ... ... each	20	0

ELECTRICAL ENGINEERING—*continued.*

	s.	d.
Alternating Current Work. By Maycock	10	6
Elementary Determinants. By Few	4	0

5.—*Machines.*

	s.	d.
The Dynamo. By Hawkins Vol. I. 21s. Vol. II.	15	0
Insulation and Design of Elec. Windings. By Fleming and Johnson	9	0
Specification and Design of Electrical Machinery. By Miles Walker	36	0
Design of A.C. Machinery. By Barr and Archibald	30	0
The Transformer. By Kapp	12	6
Transformers. By Bohle and Robertson	25	0
Electrical Machine Design. By Gray	25	0
Insulation of Electric Machines. By Turner and Hobart	21	0
Papers on the Design of A.C. Machines. By Hawkins and Neville	21	0
Electric Motors and Control Systems. By Dover	18	0
Continuous Current Motors and Control Apparatus. By Maycock	7	6
Notes on the Design of C.C. Machines. By Smith	5	0

6.—*Testing.*

	s.	d.
Practical Alternating Currents and Testing. By Smith	10	0
Practical Testing of Dynamos and Motors. By Smith	7	6
Principles and Practice of Electrical Testing. By Allen	18	0
Testing of Electro Magnetic Machinery. By Swenson & Frankenfield. } Vol. I.	16	0
} Vol. II.	15	0
Diagnosing of Troubles in Elect. Machy. By Miles Walker ...	32	0

7.—*Instruments.*

	s.	d.
Electrical Instruments in Theory and Practice. By Murdoch and Oschwald	12	6
Industrial Electrical Measuring Instruments. By Edgcumbe ...	16	0
Electricity Meters. By Gerhardi	18	0
Electrical Measurements. By Laws	27	6

8.—*Switchgear.*

	s.	d.
Electric Switch and Controlling Gear. By Garrard	25	0

9.—*Central Stations.*

	s.	d.
Power House Design. By Snell	42	0
Large Elec. Power Stations. By Klingenberg	28	0
Hydro-Elec. Power. By Lyndon. (Vol. 1., 25s., Vol. 2, 20s.)		

10.—*Transmission.*

	s.	d.
Electric Mains and Distributing Systems. By Dick and Fernie ...	18	6
Overhead Electric Power Transmission. By Still	20	0
Underground Transmission and Distribution. By Meyer	17	6
Three-phase Transmission. By Brew	9	0
Overhead Transmission Lines and Distributing Circuits. By Kapper	(a)	
Localisation of Faults in Electric Light Mains. By Raphael ...	12	6
Electrical Transmission of Energy. By Thornton...	2	6

11.—*Traction.*

	s.	d.
Electric Traction. By A. T. Dover	21	0
Single Phase Elec. Railways. By Austin	21	0

12.—*Illumination.*

	s.	d.
Illumination. By A. P. Trotter	10	6
Elements of Illumg. Eng. By Trotter	2	6

ELECTRO-METALLURGY, PLATING, etc.

	s.	d.
Electro-Metallurgy. By McMillan and Cooper	15	0
The Electric Furnace. By Stansfield	25	0
Principles of Electro-Deposition. By Field	7	6
Electro-Plating and Electro-Refining of Metals. By Watt & Philip	15	0
Electro-Plating. By Barclay and Hainsworth	7	6
Modern Electrolytic Copper Refining. By Ulke	13	6
Outlines of Physical Chemistry. By Senter	7	6
Electrolytic Deposition and Hydro-Metallurgy of Zinc. By Ralston	15	0

ESTIMATING FOR ELECTRICAL ENGINEERS.

	s.	d.
Engineer's Costs and Economic Production. By Pickworth ...	7	6
The Law Relating to Engineering. By Costello	5	0
Practical Calculations for Engineers. By Larard & Golding ...	5	0
Electrical Equipment of Collieries. By Duncan & Penman ...	12	6
Factory Administration & Cost Accounts. By Elbourne ...	45	0

WATCH MAKING—

	s.	d.
Electrical Horology. By Langman & Ball	7	6

HEATING AND VENTILATNIG ENG.—

	s.	d.
Electric Cooking, Heating, Cleaning, etc. By Lancaster, ...	4	0

BOILER-MAKERS' WORK—

	s.	d.
Fuel Economy. By Booth	2	6

RAILWAY CARRIAGE & WAGON BUILDING—

	s.	d.
Train Lighting by Electricity	3	6

ALL PRICES ARE SUBJECT TO ALTERATION WITHOUT NOTICE.

EASY TERMS OF PAYMENT CAN BE ARRANGED.

(a) Out of print. (b) New edition in preparation.

Sent to any part of the world on receipt of price plus postage. Also many of the following books are used by teachers and can be recommended for study:—

ELECTRICAL INSTALLATION WORK—

	s.	d.
"Lektrik" Light Connections. By Maycock...	1	0
Testing, Fault Localisation, etc. By Wright...	2	0
Power Wiring Diagrams. By Dover	6	0
Ship Wiring and Fitting. By Johnson	2	0
Switchgear and the Control of Circuits. By Collis	2	0
Electric Wiring, Fittings, Switches and Lamps. By Maycock ...	10	6
Electrical Installation Work. By Havelock...	15	0
Small Electric Motors, D.C. and A.C. By Painton	2	6
A.C. Protective Systems and Gears. By Marshall	2	6
Electric Cables. By Main	2	6
Industrial Electric Heating. By Beauchamp...	2	6
Practice of Electric Wiring. By Munro	5	0

ELECTRICAL ENGINEERING—

	s.	d.
Exercises in Electrical Engineering. By Mather and Howe ...	2	0
Practical Dynamo and Motor Management	0	9
Practical Illumination. By Eck...	7	0
Application of Arc Lamps to Practical Purposes. By Eck	1	0
Questions and Solutions in Magnetism and Electricity. By White...	2	6
Practical Dynamo and Motor Construction. By Marshall... ...	1	6
Arithmetic of Electrical Engineering	3	6
Arithmetic of Electrical Measurements. By Hobbs...	2	0
Arithmetic of Alternating Currents. By Crapper	4	6
Rotary Converters. By Sylvester	2	0

ELECTRICAL ENGINEERING—*continued.*

	s.	d.
Armature Winding. By Sylvester	7	6
Belts for Power Transmission. By Dunkley	2	6
Boiler Inspection and Maintenance. By Clayton	2	6
Testing of C.C. Machines. By C. F. Smith	2	6
The Diesel Engine. By Orton	2	6
Modern Central Stations. By Marshall	2	6
Standard Lighting. By 17 Experts	15	0

TELEGRAPHY AND TELEPHONY—

	s.	d.
Telegraphists' Guide. By Bell and Wilson	3	6
Arithmetic of Teleg. & Teleph. By Herbert & De Wardt ...	5	0
Telephone Troubles and How to Find Them. By Hyde	0	9
Questions and Solutions in Telegraphy and Telephony. By Few	5	6
Ditto. Ditto. Final Exams.	2	0
Text Book on Wireless Telegraphy. By Stanley. 2 vols. each	15	0
Notes on Telegraphy. By Mogg	2	6
The Western Electric Automatic Telephone System. By Anson...	1	0
Printing Telegraph Systems. By Harrison.	21	0
Automatic Telephony. By Harrison	7	6
Telephony, including Automatic Switching. By A. B. Smith ...	12	6

ELECTRO-METALLURGY—

	s.	d.
Practical Electro-Plating. By Gentry	1	6
The Electric Furnace. By Moffett	2	6
Electro Plating. By Watt	5	0

SEND YOUR ORDERS WITH REMITTANCE TO—

S. RENTELL & CO., LTD., 36, MAIDEN LANE, STRAND,
LONDON, W.C.2.

WESTON ELECTRICAL MEASURING INSTRUMENTS

PORTABLE D.C. INSTRUMENTS.

Weston Portable Direct-Current Model 45 Instruments are designed to meet the demand for a low-priced portable instrument of sufficient accuracy for Station work and general testing.

The movement of this type of instrument is completely enclosed in an iron case (which protects it from stray magnetic fields) securely fastened in a wooden carrying case, provided with a carrying handle and a hinged cover to protect the scale and binding posts. It is fitted with a knife-edge pointer, working over a mirror under the scale to eliminate error in reading due to parallax and possesses a very light moving system It will withstand a large amount of rough handling without developing pivot friction or becoming unreliable.

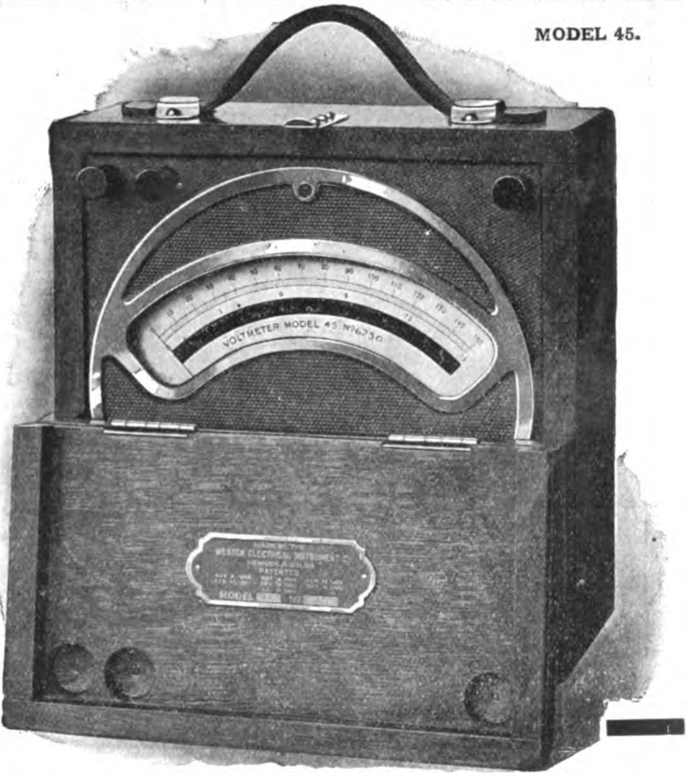
These instruments may be supplied with self-contained shunts for certain ranges, and are supplied as voltmeters, ammeters, milli-voltmeters, and mil-ammeters, or volt-ammeters of any ranges desired.

They are designed for all work in which the accuracy of our Model 1 is not desired, and owing to their excellent design, construction, and long life are cheaper than any other instruments offered for similar service.

Write for full particulars.

WESTON ELECTRICAL INSTRUMENT CO., Ltd.
15, GREAT SAFFRON HILL, LONDON, E.C.1.
Telephone: Holborn 2029. *Telegrams: "Pivoted, Smith, London."*

MODEL 45.



RHYMES from the NURSERY of THE SIMPLEST WIRING SYSTEM

1. SIMPLE SIREMAN
MET A WIREMAN
GOING TO DO SOME WIRING.

2. SAID SIMPLE SIREMAN
TO THE WIREMAN;
"I FEAR YOUR WORK IS TIRING."

3. THEN SAID THE WIREMAN
TO SIMPLE SIREMAN;
"YOU'RE BARMY, I CAN GUESS.
FOR, OUR JOBS ARE DONE WITH EASE,
NO NEED FOR ELBOW GREASE,

SINCE ST HELENS MADE THE GOOD OLD C·T·S"

ST HELENS *Cable and Rubber Co Ltd* *Phone 333* SLOUGH

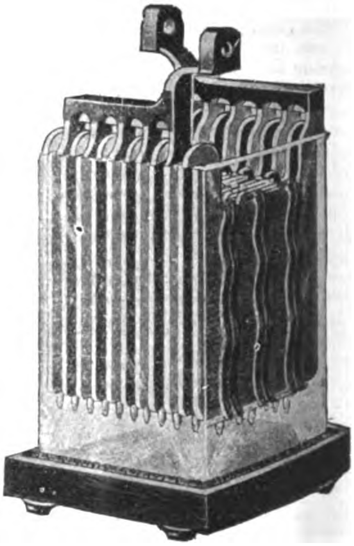
HART

THE BATTERY OF QUALITY.

HART BATTERIES ARE WELL KNOWN
FOR THEIR UNQUESTIONED

SUPERIORITY
IN
ALL ELECTRIC LIGHTING, POWER AND
PORTABLE REQUIREMENTS.

SEND FOR ILLUSTRATED PRICE LISTS TO
HART ACCUMULATOR CO., Ltd., STRATFORD, LONDON, E.15.
BRANCH OFFICES AT
BIRMINGHAM, BRISTOL, GLASGOW, MANCHESTER, WESTMINSTER & YORK



ARMATURE WINDING
and
MOTOR REPAIRS

A.C. Work a Speciality.

Re-designing and re-conditioning of any class of motor.

SAMUEL BAXTER,
Electrical and Mechanical Engineer,
102, GREYHOUND ROAD,
Phone: Hammersmith 2524. LONDON, W.6
Works and Goods Entrance in Crefold Rd. adjoining.

TRADE - STANLEY - MARK.
The largest Manufacturers of
SURVEYING & DRAWING INSTRUMENTS
in the World.

L 7 Catalogue sent post : free on application :
Contractors to H.M. : : Government : :

Quality Unsurpassed.

W. F. STANLEY & CO., LTD.,
Head Office—Show Room:
286, High Holborn, London, W.C.1.

JOHN OAKEY & SONS, LTD.
MANUFACTURERS OF
EMERY, EMERY CLOTH, EMERY PAPER,
CABINET GLASS PAPER, GLASS CLOTH,
BLACK LEAD, PUMICE, CROCUS, TRIPOLI,
ROUGE, &c.

Oakey's "Flexible Twilled" Emery Cloth.

For Engineers, Sewing Machine, Lock and Scale Makers, and all purposes where great STRENGTH, DURABILITY and PERFECT FLEXIBILITY are required.

FLINT & GARNET PAPER IN ROLLS.
50 yards long by 18 in., 20 in., 24 in., 30 in., 36 in., 40 in., 42 in., & 43 in. wide
"WELLINGTON" EMERY WHEELS.

WELLINGTON EMERY AND BLACK LEAD MILLS, LONDON, S.E.1.
ALL BRITISH MADE.

PHŒNIX
ASSURANCE COMPANY, LIMITED.
ESTABLISHED 1782
Head Office: **Phœnix House, King William Street, London, E.C.4**
Total Assets : **£30,000,000.** Claims Paid : **£185,000,000**
Chairman: **SIR GERALD H. RYAN, Bt.**
FIRE, LIFE, ACCIDENT, MARINE,
Loss of Profits following Fire, Workmen's Compensation, Fidelity Guarantee, Burglary, Trustee and Executor, &c.

ELECTRIC LIGHTING.

The Company has always encouraged the development of Electricity, and the well-known "Phœnix Fire Office" Rules for Electrical Installations are in use throughout the world. Copies will be supplied free on application to Head offices.

General Manager: **R. Y. SKETCH.**

PREPAID ADVERTISEMENTS.

Situations Vacant and Wanted, Apparatus Wanted and for Sale, Books, Miscellaneous, &c., 1d. a word. Minimum 1s. Three insertions (PREPAID) charged as Two.

Official Advertisements, Tenders, Patents, Educational, &c., 9d. a line.

Trade Display Advertisements 7s. per in.

Advertisements for this page must reach the Office by TWO O'CLOCK WEDNESDAY AFTERNOON at the latest.

Remittances for small amounts may be in halfpenny stamps.

OFFICIAL.

FOR SALE
SURPLUS GOVERNMENT ELECTRICAL STORES AT SHOEBURYNESS, ESSEX.

Six D.C. Motors, 110 volt, ½ to 7·5 h.p. One Portable Petrol Set, 8 k.w. 80 volt, 100 amps. Feeder Cubicles, Feeder Panel, Oil Switches, Transformers, Ammeters, Fuzes, Hand Switches, Table Lamps, etc.

The articles may be seen, and lists, giving details with Forms of Tender, may be had on application to:—

Officer in charge, R.E. Stores,
Suttons Yard,
Shoeburyness.

THE ELECTRICAL POWER ENGINEERS' ASSOCIATION.
HALIFAX CORPORATION ELECTRICITY DEPARTMENT.

NOTICE is hereby given that a Dispute is in operation between the above Corporation and the E.P.E.A. Before applying for any vacancies advertised by the Corporation, all Engineers are requested to communicate with the undersigned. W. ARTHUR JONES,

102, St. George's Square, General Secretary.
London, S.W. 1.

ELECTRICAL APPARATUS FOR SALE OR WANTED.

RETURNED War Searchlights, Carbons, Wire Ropes, etc., for sale. Half Price. The London Electric Firm, Croydon.

TWO New 10-way Intercommunication Desk pattern, Ericsson Telephones, 70s. each, less than half price.

Also 200 miles Highest Class Cables, 2,500 megohm grade, by Best British Makers, less than half value, 19/050, 7/16, 7/18, 7/22, 7/24. Lake, 44/47 Devonshire St., Theobalds Rd., London, W.C.1.

ANY description of obsolete Dynamos Motors, Accumulators, Arc Lamps, Old Cable Scrap Metals, etc., purchased for prompt cash. Town or country.—Learoyd, Bridge Works, Heatherley Street, Clapton, N.E. Telephone: Dalston 2278. Telegraphic address: "Frangible, Lowclap, London."

ACCUMULATORS, Second-hand, any type, wanted; also Dynamos and Machinery. Lead Peroxide, Old Copper Cable, Scrap Metals, and every description of Metallic Dross purchased for cash, Town or Country.—Write A. Brown and Sons, 142, Lower Clapton Road, E.5. Telephone No.: Dalston 555.

PLATINUM UTENSILS, SCRAP, &c.
Purchased at the Highest Prices by
Derby & Co., 44, Clerkenwell Rd., London, E.C.
Platinum Wire, Rivets and Sheets sold.
Makers of the "Lion" Pure Platinum Rivet Tremblers.

WIRELESS.

FOR SALE.—Portable Bridge sets for 6-way capacity Fuse Testing. Complete with all accessories. Suitable for calibrating wireless coils; also for Telegraph and Telephone work; general coil testing, etc., late War Dept. stock. Absolutely new. Made by the A. T. M. Co., Sullivan, Elliott, etc. Overall dimensions 9½ in. by 6 in. by 2¼in. Price 17s. 6d. post free.—Rentell, 36, Maiden Lane, Strand, London, W.C.2.

EAGLE BRAND WIRES are the best, only obtainable from Engineering Supplies, Ltd., 235A, Blackfriars Road, S.E.1. Counter open 8.30 a.m. to 6 p.m.

MISCELLANEOUS.

WORKING DRAWINGS, Ideas Developed, Calculations and Designing. Technical Photography, Telephone and Wireless Circuits. 18 years' shops and D.O. experience, I.C.S. certificates.—C. E. Mayer, 18, Geoffrey Road, Brockley, S.E.4.

PATENTS, TRADE MARKS.

THE PROPRIETORS OF THE PATENT No. 189775 FOR IMPROVEMENTS IN OR RELATING TO ELECTRIC PLUGS OF THE TELEPHONE TYPE,

are desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country.

All communications should be addressed in the first instance to: Haseltine Lake & Co., Chartered Patent Agents, 28, Southampton Buildings, Chancery Lane, London, W.C.2.

PATENT your inventions—Trade-mark your goods. Advice, Handbook and Cons. free. B. T. King, C.I.M.E. (Regd. Patent Agent, G.B., U.S.A and Canada), 146A, Queen Victoria Street, London, E.C.4. 38 years' refs. 'Phone: 682 Cent.

BOOKS, ETC.

MAGNETS AND MAGNETISM SIMPLY EXPLAINED. By A. W. Marshall, A.M.I.E.E. An elementary book of value to all interested in the first principles of magnets and magnetos. Price 10d. net, post free, from ELECTRICITY Office.

A FIRST BOOK of ELECTRICITY and MAGNETISM. By W. Perren Maycock, M.I.E.E. Deals with just those fundamental principles which underlie all practical applications, and which every practical man should be conversant with. Fourth and Enlarged Edition. Crown 8vo, 351 pages and 162 illustrations. 6s. 4d. post free from ELECTRICITY Office.

SPONS' TECHNICAL BOOKS
WRITE FOR A CATALOGUE OR REPORT OF ANY ENGINEERING OR TECHNICAL BOOK YOU MAY REQUIRE
VISIT OUR RETAIL BOOK ROOM WHERE ALL BOOKS ON ENGINEERING AND TECHNOLOGY MAY BE INSPECTED
E.&F.N. SPON Lᵀᴰ
57 HAYMARKET LONDON S.W.1.

ELECTRICITY METERS
Slot and Quarterly Types—A.C. and D.C.
CABLES, LIGHTING ACCESSORIES,
BLACO GRIP & SCREWED FITTINGS.
ROBT. HORNBY & CO., Ltd.,
7, CARLISLE STREET, DEAN STREET, W.1.
'Phone: REGENT 2410.

GAS, OIL, and PETROL ENGINES, including gas-producing plant and Humphrey Explosion Pumps. By A. Garrard, Wh. Ex. An up-to-date and clear description of the construction and operation of the various types of internal combustion engines. With 112 illustrations. Cr. 8vo, 6s. 5d. net, post free from ELECTRICITY Office.

ELECTRICAL ENGINEERING PRACTICE By J. W. Meares (Electrical Adviser to Government of India), and R. E. Neale, B.Sc. Hons., A.C.G.I. (Salomons Scholar and Siemens Medallist). A concise, non-mathematical treatise, dealing thoroughly with fundamental principles and modern practice. An expert treatment of unique scope. Fourth edition, re-written and enlarged. Vol. I., demy 8vo, 584 pp. 92 figures, 48 half-tone plates, and numerous tables 25s. net (25s. 6d. postfree). Further particulars from Rentell, 36, Maiden Lane, London, W.C.2.

THE TELEGRAPH STUDENT'S RULE for rapid and accurate drawing of circuit diagrams. The outlines of the relay, galvanometer, key, etc., are cut, stencil-fashion, in the rule, which is also divided in inches and centimetres. Useful to all Telegraphy students. Price 3s. 2d. net, post free, from ELECTRICITY Office.

WORKING OF STEAM BOILERS. By E. J. Hiller, M.Inst.C.E., chief engineer to the National Boiler and General Insurance Co. A book of direct value to every man in charge of steam plant. Sixth edition, 166 pp., 88 illus., 3s. 10d. net, post free, from ELECTRICITY Office.

CONTINUOUS CURRENT ARMATURES, their winding and construction. A handbook for students, designers and practical men. By C. Kinzbrunner, A.M.I.E.E. Cl. 8vo, 80 pp. with 79 illustrations. 6s. 6d. net, post free from Rentell, 36, Maiden Lane, London, W.C.2.

THE COOKING PROBLEM.—Why Electricity is Winning. By F. S. Grogan, M.I.E.E. An interesting paper and directly valuable in view of the high price of coal. Price 3d., post free, from ELECTRICITY Office.

THE CREED POCKET BOOK OF REFERENCE. An excellent manual for telegraph operators and mechanics. Cloth, round corners, 75 pp., illustrated. 1s. 2d. post free from RENTELL, 36, Maiden Lane, London, W.C.2.

ELECTRICAL WORKERS.

ORGANISE! ORGANISE! ORGANISE!

In the only Union which caters specially for you.

THE ELECTRICAL TRADES UNION

Branches everywhere.

Full particulars from:—

J. ROWAN, J.P., Gen. Secretary,
12a, Withy Grove, MANCHESTER.

CRIPPLEGATE MOTOR WORKS.
23, Chapel Street,
LONDON.
E.C.2.

ARMATURE REPAIRS.

Tel. No.:
Clerkenwell 3847.

PROMPTITUDE, ECONOMY, EFFICIENCY.

F. WIGGINS & SONS.
MICA Telephone: Avenue 2248.
FOR INSULATION.
Largest Stock in the World.
102, 103 & 104, Minories, LONDON, E.1.

BRITISH MICA Co., Ltd.
(Contractors to H.M. Government.)
ELECTRICAL INSULATING MATERIAL MANUFACTURERS
15, Cardington Road, Bedford.
MICA, COMMUTATOR SEGMENTS, MICANITE SHEETS, TUBES, RINGS, WASHERS, MICA POWDER, FIBRE, PRESSPAHN AND INSULATING, PAPERS, CLOTHS, TAPES, &c. MICA IMPORTERS

G.E.C.

DETACHABLE CUT-OUTS

For Circuits up to 250 volts.

now
Reduced in Price

Special significance now attaches to the G.E.C. detachable type cut-outs here illustrated, in view of the I.E.E. wiring regulations which condemn the use of cut-outs without removable carriers for circuits above 30 volts A.C. and 100 volts D.C.

The G.E.C. S.837 cut-out fully conforms to I.E.E. regulations for circuits up to 250 volts, 5 ampere capacity.

The fuse terminals are carried in the covers, which can be removed in a moment with thumb and finger. The fuse chambers are lined with refractory material which does not sustain an arc and ensures the fuse breaking inside the chamber, even on a dead short, without injury to the terminals or the china.

The patent combined cover and hand shield affords ample protection should fuse blow when cover is being replaced.

The rapidly increasing demand for these Cut-outs has enabled a substantial reduction in price to be made.

Write for full particulars.

THE GENERAL ELECTRIC CO., LTD.

Head Office: MAGNET HOUSE, KINGSWAY, LONDON, WC.2.

Branches throughout Great Britain and in all the principal markets of the world.

TRADE MARK. G.E.C. TRADE MARK.

Printed by ODHAMS PRESS LTD., Long Acre, W.C.2. Published by S. RENTELL & CO., LTD., 36-39, Maiden Lane, London, W.C.2.

UNIVERSITY OF ILLINOIS-URBANA
3 0112 064272492